# 73 Amateur Radio Today

JANUARY 1993
ISSUE #388
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A WGI Publication
International Edition

**Build a Portable CW Transceiver**

**Inexpensive SSB Filters**

**Techno-Whizzy, Part II**

**73 Reviews**

**Alinco Simplex Repeater**

**Down East**

**HF to 70cm**

**1992 ANNUAL INDE**

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# Choose Your Mobile In 3 Easy Steps:

## Step 1 Choose Your Bands!

### Single Band: 2 Meters

Today's most popular band, the best place for new hams to meet old hands, learn good operating procedures. Very friendly, thousands of open repeaters & autopatches everywhere. Great for on/off-the-road help. Crowded, though, especially in cities. Single-band mobile is easy to learn & use. No-Code friendly!

### 440 MHz

Next most popular band, less crowded with more high-tech, "smart" repeaters offering autopatch, remote base, linking, digital-voice recording. Some are limited-access (PL). Allows crossband repeating between singleband handhelds & dualband mobiles. 440 gives access to advanced technical info. This is where the pros hang out! No-Code friendly!

### 220MHz

Fairly quiet, less crowded than 440, with almost half as many repeaters and the same high-tech functions. Plenty of open channels for semi-private conversation. Great place to meet newcomers, youngsters. Ideal for ham family, since all classes have voice privileges on 220. No-Code friendly!

### 1.2 GHz

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### Multiple Band: 2 Meter/440MHz

The two most popular FM bands. A "natural" mix of high activity & special group channels, this is becoming the amateur's favorite mobile rig. Instant control of either band, and you can set up your station as a crossband full-duplex repeater. Gateway into advanced operating systems unavailable on 2M.

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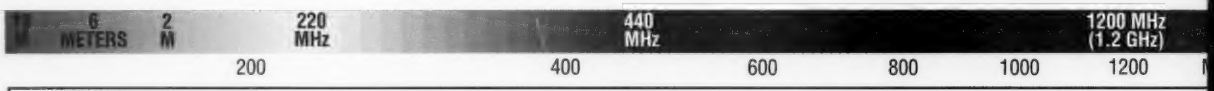
For the unconventional, this combines the most popular & the least crowded bands. Gives access to the people & services on 2M, plus the privacy & open space of 220, plus the advantages of telephone-like duplexing. Valuable where privacy is a concern.

### 2M/440MHz/1.2GHz

If you live and breathe radio, these are the bands for you! They give you the activity, the expandability and the novelty. Particularly useful for advanced hams who work in the city and live in the suburbs.

### MultiBand

Widest selection of all: start with 2M/440. Add No-Code Skywave privileges. Add 10M for and Tech-Plus privileges. Add 1.2GHz for the b If you're a shortwave buff, add scanning and Additional capacity sold as add-on modules.

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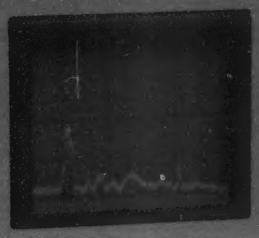

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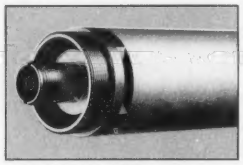

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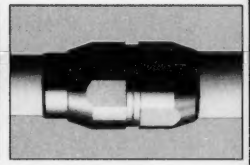

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| X-510NA | 144/440 | 8.3/11.7 | 200 | N | 17.2 | 90 |
| X-510MA | 144/440 | 8.3/11.7 | 200 | UHF | 17.0 | 90 |
| X-500HNA | 144/440 | 8.3/11.7 | 200 | N | 17.8 | 90+ |
| X-700HA | 144/440 | 9.3/13.0 | 200 | UHF | 24.0 | 90 |
| X-2200A | 144/222 | 6.0/7.8 | 150 | UHF | 11.5 | 112 |
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| U-200A | 440/1240 | 8.3/11.7 | 100 | N | 5.9 | 135 |
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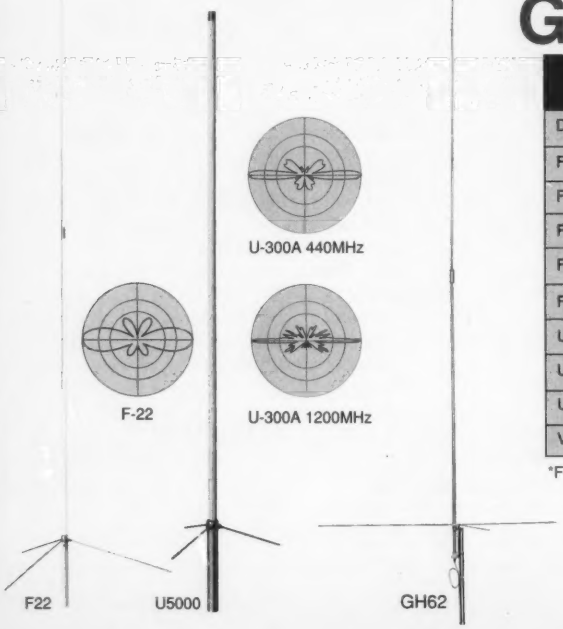
U-300A 440MHz



F-22



U-300A 1200MHz



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## TABLE OF CONTENTS


## THE TEAM

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### FEATURES


**10 The Techno-Whizzy 1, Part II**
Build a direct digital synthesis (DDS) transmitter. .....N9JZW

**16 Programmable-Frequency Audio Generator**
High accuracy with digital control. .....Redman

**24 The SP-1 Transceiver**
Build the HF "Spider." .....WA8TXT

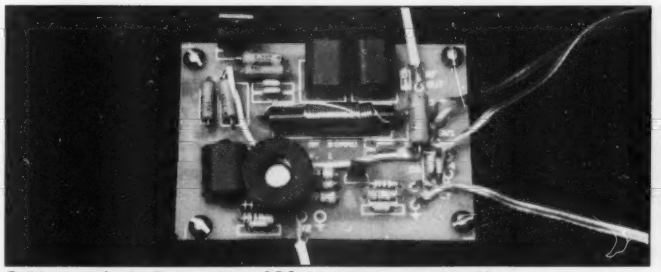
**32 Twin Crystal Ladder Filters**
Upper or lower sideband filters using inexpensive crystals. .....N2DCH

**38 Handi-Beacon**
Turn your tape recorder into a beacon controller. .....WB9YBM


### REVIEWS


**36 The Down East Microwave DEM 432K**
Put your HF rig on the 70cm band with this easy-to-build linear transverter kit. .....KT2B

**42 The SR4 Multimode Simplex Repeater**
The next generation of store-and-forward voice controllers. .....WA3USG

*Build an amp for the Techno-Whizzy DDS transmitter . . . see page 10.*

*Cover: The SP-1 transceiver. Cover photo by Mike Agsten WA8TXT.*

### DEPARTMENTS


88 Above and Beyond
81 Ad Index
70 Ask Kaboom
56 ATV
92 Barter 'n' Buy
52 Carr's Corner
64 Dealer Directory
17 Feedback Index
54 Ham Help
50 Hams with Class
46 Homing In
6 Letters
4 Never Say Die
64 New Products
72 Packet & Computers
96 Propagation
68 QRP
8 QRX
96 Random Output
76 RTTY Loop
86 73 International
78 Special Events
94 Uncle Wayne's Bookshelf
91 Updates
58 1992 Annual Index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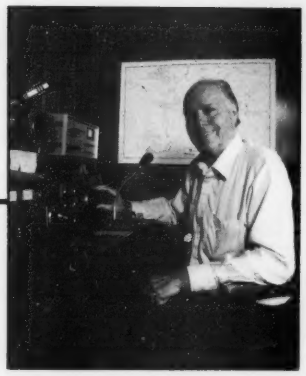
# NEVER SAY DIE

*Wayne Green W2NSD/1*



## Being One's Best

While watching one of Perot's commercials a few days before the election, I took particular note of a comment made by both Ross's family and friends that he urged them to not just be good or better, but to be the very best they could be in life. This is a philosophy worthy of consideration. It got me to thinking . . . have I done my best to be the best? How about you?

Here you are, a licensed amateur. That means you've passed the license exam. Did you do it the easy way, by memorizing the Q&As? Or did you buckle down and learn the theory which you were being tested on? And since you've gotten your ticket have you been trying to learn more? I wish I didn't know the answer to that.

As an amateur you have the opportunity to get involved with a wide variety of activities. How much advantage have you taken of this incredible opportunity? Are you marking time through what's left of your life talking about nothing at great length on 2m or one of the low bands?

Being the best in amateur radio means different things to different folks. To me it means learning as much as you can. It means exploring every mode and every band. It means working DX, going on DXpeditions, working packet, RTTY, SSTV, moonbounce, OSCAR, transmitter hunts, ham club work, helping put on hamfests, helping with emergencies, handling traffic, helping newcomers get licensed, building equipment, winning contests, running a repeater, pioneering new modes or technologies, making friends for America in other countries, and even serving your country in time of war.

Then there's being your best at your work. What a shame it is when parents don't teach their children the importance of being their very best. To me that means knowing more about my work than my competitors. It means endlessly doing my homework . . . which isn't actually work because it's fun. It means attending conferences, taking classes, reading books, subscribing to magazines. I just bought a new stack of books and am working my way through them. Some are tedious to read because they're so poorly written, but most are wonderful and give me lots of ideas.

When I took on my responsibility as a member of the New Hampshire Economic Development Commission I refused to let the politicians and their efforts to block the Commission from doing anything of significance hold me back. Ross's idea resonated with me.

Whenever I take up a new interest I tend to go at it whole hog. When I got interested in horseback riding I took lessons . . . and more lessons. I found better and better experts and soon I was teaching riding instructors myself. When I got into sports car rallying I first learned to navigate and then to drive. I developed a new navigation system which filled shelves with trophies. I needed special watches which would keep time accurately all day so I found a factory in Germany to make them for me and I imported them. I discovered a special pepper-grinder-like calculator used in Europe for currency conversions, but which was ideal for rallying. I went to the Curta factory in Liechtenstein and made a deal to import them for rallyists. I developed and printed my own rally tables, which were incredibly simple compared to those made by others. My customers were soon winning all the rallies.

When I got interested in photography I read books, took lessons and spent endless hours in the school darkroom building my skills. I armed myself with everything from 35mm to 5x7 cameras. This helped me greatly when I became a TV cameraman at WPIX in New York and knew how to compose pictures . . . and later when I was a TV director in Dallas and in Cleveland, I helped my cameramen get great pictures. In my early publishing days I took most of my own pictures.

I didn't take up skiing until I was 44, but then I went at it furiously. I took lessons and more lessons. In just a few weeks I was skiing better than I ever thought I'd be able to in my life. So I took even more lessons. Now, at 70, I'm brittler and thus a bit more cautious in the trails I ski since breaking something would be extremely inconvenient, but I still tear down the mountains, having more fun than should be legal.

Somehow my parents got across to me the concept of trying to be the best I could at whatever I got interested in. I've been preaching this idea in my editorials, hoping others would see the value of this approach to life and adopt it. So how about you? Do you settle for less than the best in what you do? Are you the best at work? Are you achieving your best in amateur radio? Are you learning all you can or are you cheating yourself? When you goldbrick through life you're only cheating yourself.

Let's see, what is there to do in amateur radio that I haven't done yet? What new challenge is there for me? What challenge is there for you? What haven't you done yet? Why not? What are your excuses?

### Chess

How's your chess game? Chess is a wonderful game to teach kids because it's totally skill, with no chance element whatever. When you get involved with chess you soon discover that the more you learn about the game, the better you play. A good player will always trounce a lesser player. Aha! So how does one get to be a good player? You do that the same way you get good at anything else . . . you read a lot about it and you take some lessons from an expert. You'll have to memorize hundreds of openings, and thousands of endgame closings. You learn to be aggressive or lose. The fact is that the game of chess is a wonderful teacher for life. It'll teach you the fundamentals of business. You'll learn to do your homework, be aggressive, and look for creative new approaches to old situations. You'll learn the value of persistence.

Go is another game of skill and its popularity in Asia has a good deal to do with the way the Asian countries have been running circles around us in business. Chess and Go teach qualities which are valuable to a country. They help teach the work ethic. You don't win at chess unless you work at it, but if you do you'll surely win. That's great training for life.

### Fear

One thing that's been bugging me is why so few hams have actually tried packet radio. I wonder if it has something to do with fear? A fear of embarrassment of making mistakes when you're into something completely new? A fear of displaying your own ignorance of both radio and computers? A fear of the unknown?

It isn't as if it costs much to get involved with packet radio. And it isn't as if you don't know that there are several thousand hams having a ball with it.

So let's look at this fear thing and see if we can understand it better. People generally fear things they don't understand, right? So let's look at the other side of that coin. Are there any things you understand that you fear? I said fear. I'm not afraid of electricity, I respect it. I've gotten knocked on my kiester a couple of times and that's generated a surprising amount of respect. But it's not fear or terror.

Once we take the trouble to find out more about the things that we are afraid of we no longer are afraid. I'm afraid when I'm walking on a New York street at night and a group of black or Hispanic teenagers pass me. I'm afraid because I don't know whether they are dangerous or not. It's the unknown. If I were to take the trouble to get to know them I would no longer be afraid.

The next time fear hits, perhaps you can consider that if you understood what you are afraid of you wouldn't be afraid. So, instead of fearing and probably running away or avoiding, try to find out more about what has frightened you . . . knowing that this will eliminate your fears.

Religions rule billions of lives through fear. Fear of punishment for sins. Fear of the devil, of hellfire, and so on. I can't fault them for that because it pays off. It pays off in billions of dollars. We have some extremely wealthy religions, all built on fear. But you know, we haven't a shred of proof that any of these fears are real. Millions of people believing things doesn't make them true, otherwise the sun would still be spinning around the earth and Columbus would have fallen off the edge of the world.

Now, are you ready to give packet a try? It's wonderful fun and you're missing a whole big piece of our hobby. Yes, of course you're going to have to learn a lot. And you're going to make all kinds of dumb mistakes. Hey, there's always a first, right?

Step two . . . I expect a letter from you thanking me for pushing you into this.

### Reason Prevails

The League has backed down on their opposition to automatic relaying on the low bands. I'll let the packeteers give you the gory details on what happened.

I can understand concerns about the blind relaying of messages, where there would be a strong possibility of jamming contacts already in progress. This is much like K1MAN or W1AW coming on their self-assigned frequencies and broadcasting blind.

Most of us pick what sounds like an unused frequency and then ask if anyone is using it before we launch into a long CQ. Perhaps the packet software developers can get our packet (and RTTY) systems to emulate this approach. If a relay station could send a short coded signal which would ask if

*Continued on page 66*

KENWOOD

...pacesetter in Amateur Radio

# In Gear

Powered up for prime-time mobile communications

**Kenwood's TM-241A (144MHz), TM-331A (220MHz), TM-441A (440MHz), and TM-541A (1200MHz) mobile transceivers offer sports-car performance with family-car convenience.**

- **High power**
  The TM-241A provides 50W, TM-331A is 25W, TM-441A 35W, and TM-541A 10W. Three power positions: 5, 10 and full. The TM-541A has two power positions: 1 and 10 watts.
- **Wideband receiver coverage**
  The TM-241A receives from 118 to 173.995MHz; transmit range is 144–148MHz (modifiable for MARS and CAP operation, permits required). Other ranges are 215–230MHz (TM-331A), 438–449.995MHz (TM-441A), and 1240–1299.995MHz (TM-541A).
- **20 memory channels**
  20 multi-function memory channels store frequency, repeater offset, sub-tone frequencies, and repeater reverse data. Repeater offset on 2m is automatically selected. There are 4 channels for "odd split" operation.
- **Multiple scan modes**
  Band and memory scan, with selectable scan stops and memory channel lock-out.
- **CTCSS built-in**
  Selectable from front panel (optional KQT-8 decoder available).
- **Selective calling & pager option**
  The DTU-2 option enables DTSS (Dual-Tone Squelch System) for selective calling and paging using standard DTMF tones. Elapsed time is shown by the tone alert system. (TM-241A/441A/541A)
- **Digital recording system option**
  Used in conjunction with the tone alert system, this allows message storage of up to 32 seconds.
- **Large LCD display**
  Features 4-step dimmer control.
- **Supplied accessories**
  Mounting bracket, DC cable, fuses, multi-function DTMF mic.
- **Choice of accessories**
  A full line of mics, speakers, and other accessories is available. See your authorized Kenwood Amateur Radio dealer for details!

*Specifications guaranteed for Amateur band use only.*

TM-241A TM-331A

TM-441A TM-541A

# TM-241A/331A/441A/541A

## Mobile Transceivers

KENWOOD U.S.A. CORPORATION
COMMUNICATIONS & TEST EQUIPMENT GROUP
P.O. BOX 22745. 2201 E. Dominguez Street. Long Beach. CA 90801-5745
KENWOOD ELECTRONICS CANADA INC.
6070 Kestrel Road. Mississauga.Ontario. Canada L5T 1S8

# LETTERS

Number 2 on your Feedback card

## From the Hamshack

**Joel Weder VE6VOX, Calgary, Alberta, Canada** I was reading my July/August copy of *The Planetary Report* (published by The Planetary Society, which promotes space exploration) and came across a rather interesting article, "Doing More With Less: The New Way of Exploring the Solar System," by Rex Ridenoure. The article discussed the trend towards smaller and more cost-effective space probes. What's interesting about it for you and me is his description of the rate of technological change involved: " . . . the SDI and commercial space segments are three to five years ahead of the space exploration field in developing and applying new satellite technology; these groups were preceded by the academic and amateur radio communities."

These days everyone (Wayne especially) seems to be wondering where amateur radio is going—what will be our reason for being. Well, I think this article just shone a little light on the path. There are still hams experimenting at the forefront of technology, whether it be with OSCAR, packet or repeater linking via satellite. The club that I recently joined here in Calgary (CARA) is one of the most progressive I've seen because (it seems to me) they keep politics to a minimum, aren't afraid to jump into a new project and concentrate on getting things done. Those are, as any good businessman knows, among the central keys to success.

I recently gave up a well-paying job as a military photographer to go to college. Most of my friends think I'm crazy to do such a thing during a recession, but when I graduate as a telecom technologist it'll "open a whole new world" to me. I guess my point is that we, as amateurs (and North American society as a whole), need to be willing to take chances on change and innovation. We cannot allow ourselves to continue being afraid of the future.

**David K. Hansen KBØEVM, Jeddah, Saudi Arabia** Greetings from Jeddah, Saudi Arabia. Amateur radio is pretty limited here, although the Oasis Amateur Radio Club has been in operation since last February. The call is 7Z2AB and our QSL manager is AAØBC. There are about 15 hams on the roster and many activities going on. The equipment includes an ICOM 725; a Kenwood 440S; beams for 12 and 17 meters, and for 10, 15, 20 and 40 meters. Our hours are somewhat limited, but any availability of operation is appreciated. As you can imagine, we usually get quite a pileup when we get on the rig.

I have been here for eight years, arriving as a private and commercial pilot ground instructor and have moved to being the senior instructor for 747 avionics systems instruction for the flight crews. My former occupation was as a physics teacher in a high school in Minnesota. Wayne, I do agree with some of your conclusions in your editorials concerning the education of youth. However, it is easy to use a big brush and to think every classroom is the same. There is a lot of quality out there. Granted, there may be less than in previous decades, and the objectives of education may not be appropriate to today's required work force. So, why am I not still in the classroom? I had given a lot of effort to the students, received several awards for teaching excellence, and received little support from the local administration. I did what I wanted to do, did well, but received nothing extra beyond what an "average" teacher would receive. Finally, teaching college placement physics, standard physics, and aerospace; and acting as radio club advisor, chess club advisor, faculty social committee chairman, athletic field manager and science department chairman wiped me out. The number of students increased and the money available for supplies went down. How do you teach physics when the annual money per student for all supplies is less than a meal for two at McDonald's?

Until the business world and the public want to have responsive, quality schools and are willing to support appropriate school goals emotionally and financially, there will be little change. I did get tired of music departments getting personal computers to maintain inventories of instruments, uniforms and candy sales while the science department uses instructor-purchased computers. It was that or have none. But then, music and athletic departments have their parent support groups. Maybe there should have been a science concert some evening.

There will continue to be young dreamer teachers, there will be those who sacrifice their own family time to do a good job, but somewhere around the 30- or 40-somethings they look in the mirror and make some inner comment about "what is this getting me?"

Let me get off the soap box and to the main reason for writing. Being here I can appreciate the restrictions on radio operations. I only hope that amateurs are picking up the baton and doing something about getting young people interested and upgrading their own skills in a few of the multiple areas of amateur radio. A suggestion I would make is to adopt a library, either a school or public library. Make it a normal practice to donate a book on electronics or amateur radio on each of your birthdays or on July 4th as a birthday gift to the country. Skip that meal out in the restaurant and donate a book instead. Send the XYL a card and tell her that her flowers were converted into a book. Encourage others to do the same.

**Fred E. Piering WD9HNU, Maitland FL** My God! Wayne, what's this world coming to? Since the birds have left the nest, my wife has contemplated starting a small business, such as a grocery shopping and delivery service for the elderly or infirm (she likes to spend other people's money—read: mine). So, when I read your editorial in the November issue I showed her the section you wrote concerning "Making a Buck." When I found her reading page 76 I inquired, "What are your doing?" She responded that she found you very interesting and profound, very informative!

She asked how long you had been writing editorials and I told her 30+ years that I could remember (I still have some *73*s from the beginning). Well, now I am under strict orders that from now on when I receive my *73* in the mail, I am to turn it over to her so she can read your editorials. Maybe she should pay for the next subscription?

**L. E. Dickason N8MKM, Jackson OH** Wayne, your June editorial requires some comment. I agree that 20 wpm is a little silly in our digital world. I am a Tech with 5 wpm, but I really can't see the value in suffering through the code to upgrade. Why not a series of tests which emphasize theory, rules and COURTESY?

I started reading *73* as an SWL because you had good articles on antennas and other topics and because you didn't talk about SWLs as if they were vermin. It takes more than glossy paper to make a magazine.

Speaking of high-tech, I would like to build a digital signal processor and a panadaptor or spectrum analyzer. Where are the projects? I enjoy "Above and Beyond" because it pushes my understanding to the limit. Isn't that what it's all about?

**Guy Metrocavich, via Instinet** I thought Sheets and Graf's article titled "ATV Transmitter, Part I" (August 1992) was great. I enjoyed the thorough yet concise circuit description. For example, the description of the C1 oscillator gave me all I needed to understand how it worked.

I have seen this oscillator in circuits for years and never figured it out. I always looked for feedback from the emitter or collector to the base; I did not realize it was a common base configuration.

The rest of the article was equally insightful. Thank you.

**Jim Kocsis WA9PYH, South Bend IN** Wayne, I thought I'd better write to you and let you know that I've been taking some (not all!) of your advice. First of all, I'm a subscriber since 1965 so I'm a long-time reader of *73*.

Ham radio is alive and well in our town and I'm fairly active, but I thought I would share some info with you and *73*'s readers on non-ham-radio subjects. I read a lot and have read some very interesting books in the past few years. There are much more interesting things and thoughts going on in the world than what the AP, UPI, etc. think we should know.

Why am I mentioning this in a ham radio magazine? Only to prod people to talk about more interesting things than RST, the rig, weather, QSLs, etc. My gosh, we have a "meeting room" that spans the country (actually the world!) that we can use 24 hours a day for free and we are not doing it! I've tried skipping the rubber-stamp QSO format and have had some excellent discussions with fellow hams. I heavily recommend this to the readers of *73*.

As far as TV is concerned, I personally only watch a few shows regularly. I want to be informed or entertained (made to laugh, not depressed!). What can you do in your spare time if you don't want to yak on the air? Anything! But don't waste your time doing the same thing over and over and over again. My gosh, we're not robots (or are some of you?). And if you can't read when there is time (my eyes get tired at night but I still feel like I need some input) there are tapes at your local library that are instructive, entertaining or just pleasing to the mind. Did you ever try listening to one of those subliminal tapes (weight reduction, controlling anger, dealing with angry people—the list is endless)? Did you ever try listening to a tape on self-hypnosis? Or music from another culture? There are tapes that are condensed versions of some very good books.

Now, after you've read something off the beaten path, try telling someone you contact on the air about it and discuss it—you will be pleasantly surprised by their reaction! Ditto for people at work. Mostly what I've heard is: "Gee, I always wanted to know about that . . . but I never had the time."

How about it Wayne, am I right? The most exciting things are the unknown and the new, not the same old same old.

Please keep "on our cases" Wayne, we need the constant motivation!

## Low Cost GaAsFET PREAMPS

### LNG-(*)

*ONLY $59* wired&tested

**FEATURES:**
- **Very low noise:** 0.7dB vhf, 0.8dB uhf
- **High gain:** 13-20dB, depends on freq
- **Wide dynamic range** - resist overload
- **Stable:** low-feedback dual-gate FET

**Specify tuning range: 26-30, 46-56, 137-152, 152-172, 210-230, 400-470, 800-960 MHz.*

### LNW-(*) MINIATURE PREAMP

**ONLY $29 kit, $44 wired&tested**

- GaAs FET Preamp similar to LNG, except designed for **low cost & small size.** Only 5/8"W x 1-5/8"L x 3/4"H. Easily mounts in many radios.

**Specify tuning range: 25-35, 35-55, 55-90, 90-120, 120-150, 150-200, 200-270, 400-500 MHz.*

### LNS-(*) IN-LINE PREAMP

*ONLY $89 kit, $119 wired&tested*

- GaAs FET Preamp with features similar to LNG series, except **automatically switches out of line during transmit.** Use with base or mobile transceivers up to 25W. Tower mounting brackets incl.

**Tuning range: 120-175, 200-240, or 400-500.*

### HELICAL RESONATOR PREAMPS

- GaAs FET preamps with 3 or 4 section helical resonators **reduce intermod & cross-band interference** in critical applications. **MODEL HRG-( * ), *$80 vhf, $110 uhf.*** **Specify tuning range: 142-150, 150-162, 162-174, 213-233, 420-470.*

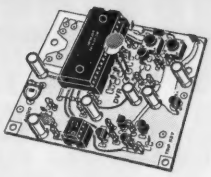
## RECEIVING CONVERTERS

Low noise converters to receive vhf and uhf bands on a 10M receiver.
- **Kit less case *$49*, kit w/case & BNC jacks *$74*, w&t in case *$99*.**
- Input ranges avail: 50-52, 136-138, 144-146, 145-147, 146-148, 220-222, 222-224 MHz, 432-434, 435-437, 435.5-437.5, and 439.25 (to chan 3).

## TRANSMITTING CONVERTERS

**XV2 for vhf and XV4 for uhf.** Models to convert 10M ssb, cw, fm, etc. to 2M, 220, 222, 432, 435, and atv. 1W output. ***Kit only $89.*** PA's up to 45W available.

## ACCESSORIES



NEW DVR-1 DIGITAL VOICE RECORDER Module. Primarily a **voice ID'er for repeaters**. May also be used as a **contest CQ caller** or as a **"radio notepad"** to record up to 20 seconds of received transmissions for instant recall. As a **repeater ID'er,** it will record your voice, using either the built-in microphone or an external mic. It can be used with almost any repeater COR module. As a **contest caller,** you can record a message or even several messages and play them through your transmitter at the press of a switch. As a **radio notepad,** you can keep it wired to the audio output of a receiver ready to record up to 20 seconds of anything you might want to recall later. Play it back as many times as you like through a small external speaker. (Call for more information.) .....kit $89, w&t $139

TD-3 SUBAUDIBLE TONE DECODER/ ENCODER. Adjustable for any tone. Designed **especially for repeaters,** with remote control activate/deactivate provisions ....kit $29, wired & tested $69

COR-3 REPEATER CONTROLLER. Features adjustable tail and time-out timers, solid-state relay, courtesy beep, and local speaker amplifier ..... kit $49

CWID. Diode programmed any time in the field, adjustable tone, speed, and timer, to go with COR-3 ..... kit $59

COR-4. Complete COR and CWID all on one board for easy construction. CMOS logic for low power consumption. Many new features. EPROM programmed; specify call ..... kit $99, w&t $159

TD-2 TOUCH-TONE DECODER/CONTROLLER. Full 16 digits, with toll-call restrictor, programmable. Can turn 5 functions on/off. Great for selective calling, too! .....kit $89, wired & tested $149

NEW TD-4 SELECTIVE CALLING Module. Economy touch-tone decoder with 1 latching output. Primarily designed to mute speaker until someone calls you by sending 4-digit tt signal but may also be used to turn on autopatch or other device..... kit $49, w&t $89

AP-3 AUTOPATCH. Use with above for repeater autopatch. Reverse patch and phone line remote control are std. .....kit $89, wired & tested $149

AP-2 SIMPLEX AUTOPATCH Timing Board. Use with above for simplex operation using a transceiver ..... kit $39

MO-202 FSK DATA MODULATOR. Run up to 1200 baud digital signals through any fm transmitter with full handshakes. Radio link computers, telemetry gear, etc. ..... kit $49, w&t $79

DE-202 FSK DEMODULATOR. For receive end of link. ..... kit $49, w&t $79

9600 BAUD DIGITAL RF LINKS. **Low-cost** packet networking system, consisting of MO-96 Modem and special versions of our 144, 220 or 450 MHz FM Transmitters and Receivers. Interface directly with most TNC's. Fast, diode-switched PA's output 15 or 50W.

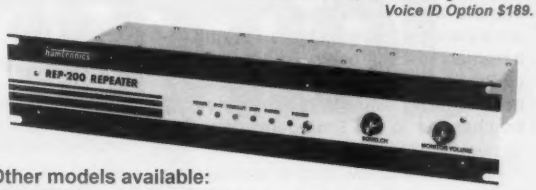
NEW **Real-Speech Voice ID Option Available With DVR-1 Digital Voice Recorder Shown At Left!**

# REP-200 REPEATER

**A microprocessor-controlled repeater with autopatch and many versatile dtmf control features at less than you might pay for a bare-bones repeater or controller alone!**

**We don't skimp on rf modules, either! Check the features on R144 Receiver below, for instance: GaAs FET front-end, helical resonators, sharp crystal filters, hysteresis squelch.**

***Kit $1095; w&t only $1295!***
*Voice ID Option $189.*




### Other models available:

**REP-200V Economy Repeater.** As above, except uses COR-4 Controller without DTMF control or autopatch. **Kit only $795, w&t $1095.**

**REP-200N Repeater with no controller.** For use with external controller, such as those made by ACC. **Kit only $695, w&t $995.**

- Available for the 50-54, 143-174, 213-233, 420-475, 902-928 MHz bands.
- *FCC type accepted for commercial service (hi-band and uhf).*
- **Rugged exciter and PA**, designed for continuous duty.
- Power out 20W 50-54MHz; 15W (25W option avail.) 143-174MHz; 15W 213-233 MHz; 10W uhf; 10W 902-928MHz.
- Available add-on PA's **up to 100W.**
- **Six courtesy beep types**, including two pleasant multi-tone bursts.
- **Open or closed access autopatch, toll-call restrict**, auto-disconnect.
- **Reverse Autopatch,** two types: auto-answer or ring tone on the air.
- Pulse (rotary) dial option available.
- **DTMF CONTROL:** over 45 functions can be controlled by dtmf command. 4-digit control code for each function.
- **Owner can inhibit** autopatch or repeater, enable either open or closed access for repeater or autopatch, and enable toll calls, reverse patch, kerchunk filter, site alarm, aux rcvr, and other options.
- Cw speed and tone, beep delay, tail timer, and courtesy beep type **can be changed at any time** by owner password protected dtmf commands.
- **Auxiliary receiver input** for control or **cross linking repeaters.**
- Many **built-in diagnostic** and testing functions using microprocessor.
- Color coded **LED's indicate status** of all major functions.
- **Welded rf-tight partitions** for exciter, pa, receiver, and controller.
- 3½ inch aluminum rack panel, finished in eggshell white and black.

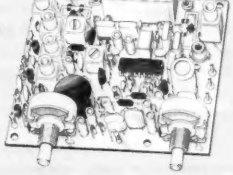
## XMTRS & RCVRS FOR REPEATERS, AUDIO & DIGITAL LINKS, TELEMETRY, ETC.

**Also available in rf-tight enclosures, and with data modems.**

FM EXCITERS: 2W continuous duty. TCXO & xtal oven options. ***FCC type accepted for com'l high band & uhf.***

- **TA51**: 50-54, 143-174, 213-233 MHz ...kit $109, w&t $189.
- **TA451**: 420-475 MHz ...kit $109, w&t $189.
- **TA901**: 902-928 MHz, (0.5W out); w&t $219.
- **VHF & UHF AMPLIFIERS.**
- For fm, ssb, atv. Output levels from 10W to 100W. Several models starting at $99.

FM RECEIVERS:



- **R144/R220 FM RECEIVERS** for 143-174 or 213-233 MHz. **GaAs FET** front end, 0.15uV sensitivity! Both crystal & ceramic if filters plus **helical resonator** front end for exceptional selectivity: >100dB at ±12kHz (best available anywhere!) Flutter-proof hysteresis squelch; afc tracks drift. ...kit $149, w&t $219.
- **R451 FM RCVR,** for 420-475 MHz. Similar to above. ...kit $149, w&t $219.
- **R901 FM RCVR,** for 902-928MHz. Triple-conversion, GaAs FET front end. ...$169, w&t $249.
- **R76 ECONOMY FM RCVR** for 28-30, 50-54, 73-76, 143-174, 213-233 MHz, w/o helical res or afc. ...Kits $129, w&t $219.
- **R137 WEATHER SATELLITE RCVR** for 137 MHz. Kit $129, w&t $219.

- Buy at low, factory-direct net prices and save!
- For complete info, call or write for free catalog.
  *Send $2 for overseas air mail.*
- Order by mail, fax, or phone (9-12 AM, 1-5 PM eastern time.)
- Min. $5 S&H charge for first pound plus add'l weight & insurance.
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CIRCLE 57 ON READER SERVICE CARD

# QRX . . .



## The Emergency Broadcast System Today

**Hearing "this is only a test" broadcast by your local radio station may become a thing of the past.** The FCC has announced a "comprehensive attic-to-basement" plan to overhaul the Emergency Broadcast System (EBS). EBS has not been updated since 1976. Its name may be changed to the Emergency Warning System (EWS).

Proposed is a new form of silent testing and a cutback (from weekly to monthly) in the amount of on-air testing. Actually, new equipment will be able to test itself.

The FCC is suggesting a new "subaudible" warning system that will preclude using the familiar 20-second tone that mixes 853 Hz and 960 Hz together in order to activate emergency listening devices.

Cable operators, who currently do not have to perform EBS tests, will be required to join TV and radio broadcasters.

In 1991, EBS was used more than 1,500 times. The Emergency Broadcast System was activated nearly a day before Hurricane Andrew hit the south Florida coast.

EBS was established in 1951 as the CONELRAD (Control of Electromagnetic Radiation) system during the Truman administration to provide the president with the means of addressing the American people in the event of a nuclear attack. The service has yet to be used during a national emergency.

The Truman administration envisioned that the President or a government agency would activate the tone to control a master radio or television station, one specifically constructed to withstand an atomic explosion. The station's command tone would be heard by other stations, linked in a pyramid: Those stations would be heard by other stations, and so on.

Currently, EBS is only used at the local level to notify the public of dangerous conditions: toxic leaks, tornadoes, hurricanes, chemical fires, earthquakes, floods and such. The EBS was even used during the LA riots to call off-duty police officers back to work. *TNX The F.O. Flyer, October 1992.*

## Youth Forum Interviewees Needed

**Carole Perry WB2MGP is seeking articulate, active amateur radio youngsters** up to age 18 to be interviewed for various youth forums across the country. Please contact Carole at P.O. Box 131646, Staten Island NY 10313-0006, or call her at (718) 983-1416.

## Congress Enacts New Restrictive Scanner Law

**The law prohibiting the manufacture of scanners with (or easily modifiable to include) the cellular bands passed the Senate** (reportedly *without* debate) on October 8th. The "cellular ban" was an amendment to the FCC funding bill and it is entirely possible and even probable that most senators had *no* idea the cellular amendment was there or what it meant. The following comments, which have appeared in several places, are speculation until an official interpretation is published:

(1) Receivers with external converters, lab-type receivers and tunable receivers are *not* affected by this law. *Scanners* are affected. Once the law goes into effect (180 days from October 8, 1992), no scanner can be manufactured that will cover the cellular bands, nor can it be made to be easily modified.

(2) It looks as though as long as the scanner is made with a *continuous* large frequency range, you can include the cellular frequencies.

(3) This law *does not* affect used scanners or scanners that were manufactured prior to the effective date of the law.

Here is the exact text of the new law:

*Sec.408. INTERCEPTION OF CELLULAR TELECOMMUNICATIONS.*

*(a)AMENDMENT—Section 302 of the Communications Act of 1934 (47 U.S.C.) is amended by adding at the end the following new subsection:*

*(d)(1) Within 180 days after the date of enactment of this subsection, The Commission shall prescribe and make effective regulations denying equipment authorization (under Part 15 of Title 47, Code of Federal Regulations, or any other part of that title) for any scanning receiver that is capable of—*

*(A)receiving transmissions in the frequencies allocated to the domestic cellular radio telecommunications service,*

*(B)readily being altered by the user to receive transmissions in such frequencies, or*

*(C)being equipped with decoders that convert digital cellular transmissions to analog voice audio.*

*(2)Beginning 1 year after the effective date of the regulations adopted pursuant to paragraph (1), no receiver having the capabilities described in subparagraph (A), (B), or (C) of paragraph (1), as such capabilities are defined in such regulations, shall be manufactured in the United States or imported for use in the United States.*

*[By Roy J. Cloutier, adapted from public postings on Prodigy. TNX Westlink Report #637, November 12, 1992.]*

## Space Symposium a Great Success!

The Tenth Annual AMSAT-NA Space Symposium and meeting was held at the beautiful Intelsat Headquarters building in Washington, DC, on October 9-11. The 300 in attendance heard presentations on such diverse subjects as antenna testing for the Phase-3D spacecraft, use of the PACSATs, SAREX hardware configurations and the AMSAT awards program. Once again this year, the ARRL co-sponsored an educational workshop at the Symposium. A complete satellite station that was installed for the weekend was used to make several AO-10 and AO-13 contacts, including a scheduled QSO with a special event station at the AMSAT-Denmark meeting being held in Copenhagen.

Dr. Ron Parise WA4SIR was the banquet speaker. He entertained the audience with a talk, slides, and a movie detailing the Astro-1 space shuttle mission on which he was a payload specialist and SAREX operator. The evening ended with presentations of awards and a drawing for the numerous door prizes that were generously donated by many different companies.

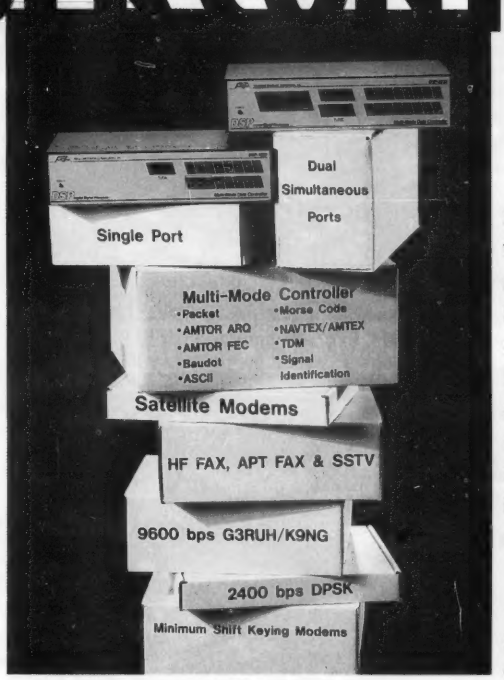
The printed proceedings (32 papers, almost 300 pages total) are available from AMSAT-NA Headquarters. Look for a detailed report on the meeting and symposium in the next issue of the *AMSAT Journal. TNX AMSAT-NA; Westlink Report #637, November 12, 1992.*

## TNX . . .

**. . . to all our contributors!** You can reach us by phone at (603) 924-0058, or by mail at *73 Magazine,* Route 202 North, Peterborough NH 03458. Or get in touch with us on CompuServe ppn 70310,775; MCI Mail "WGEPUB"; or the 73 BBS at (603) 924-9343 (300-2400 bps), 8 data bits, no parity, one stop bit. News items that don't make it into *73* are often put in our other monthly publication, *Radio Fun.* You can also send news items by FAX at (603) 924-9327.

# WE'VE GOT EVERYTHING UNDER CONTROL

FREE "GET STARTED in PACKET" book with purchase of any AEA packet controller! Good 10/1/92 – to – 2/28/93




In the world of multi-mode contollers, nothing tops the DSP-2232 or DSP-1232 from AEA. When you choose either the dual port DSP-2232 or single port DSP-1232, you'll have just what you need to couple HF or VHF/UHF (or both) transceivers with a personal computer or computer terminal. Each converts incoming analog signals into digital data by means of a 12-bit, high speed converter.

Developed by AEA — with over 10 years of multi-mode controller development experience — the DSP-2232/1232 are the most advanced and versatile controllers available anywhere. They give you the capability to control all legal Amateur digital modes popular on both HF and VHF. New modems only require new software which can be installed with an EPROM chip, or downloaded from a telephone BBS binary file into the DSP's RAM. You won't need to replace your DSP-2232 or DSP-1232 as no new hardware or modifications will be needed as new modes become available.

Whatever you've thought about doing in Amatuer radio, it's here in the DSP-2232 /1232. All PK-232 MBX modems (Packet, AMTOR, etc.). All satellite modems (PSK, 4800 bps PACSAT, G3RUH 9600 bps, U022 equalized, 400 bps OSCAR-13). Analog modems for HF FAX, FAX APT, and SSTV. 9600 bps K9NG/G3RUH for terrestrial and satellite use. Each also offers internal RAM for up-loading modems, up to 36 simultaneous packet connections, EPROM up to 2 Mbits, software selectable radio ports, Mailbox accessible through both ports, dedicated printer port, RTTY digital noise gate, ARQ tolerance command, etc.

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# The Techno-Whizzy 1, Part II

## *Build a direct digital synthesis (DDS) transmitter.*

by John Welch N9JZW

In Part 1 of this article, we built the VFO, frequency selector and power supply boards. Using just these, you have a very QRP transmitter (2 milliwatts) or a nice signal generator. For those who like a transmitter with a little more oomph, here's the amplifier stage.

Since we've gone through a lot of trouble and expense to generate nice, clean, pure sine waves, it would be a real waste to run it through a class-C amplifier. Class C would also require a filter for every band or two, complicating things even more. Class A is the right approach (with the added benefit that when we make the TW-1 do SSB we won't need a new amp).

Designing a class-A power amplifier wasn't easy (digital likes me; analog hates me). The amplifier was designed to be easy-to-build, requiring no adjustments. It is not, however, the most efficient or powerful design. The amplifier will remain linear down to about 10 volts, and remain within maximum specs up to 13 volts. It is designed to run from a freshly-charged 12-volt battery or 13.8-volt power supply. More than 13.8 volts won't give you more power—it will just burn up the final amp!

Class A has its drawbacks—namely, it consumes more power than class C and consequently also runs hotter than class C. I've sidestepped this issue by keying power to both the driver and the final stage, so it will only consume that power and generate that heat while you have the key down. This also sidesteps another common problem—stray RF getting into the final and being amplified to a low-level signal.

### Theory of Operation

The RF signal at about 1.5-2 mW comes into the base of Q2 at J2. Resistors R5, R3 and the transistor combine to present a 50-ohm load to the input. Emitter resistors R6 and R7 keep the driver Q2 stable, limit current flow and, combined with bypass cap C3, provide some frequency-dependent output compensation. The output runs through C2 to a 4:1 step-down transformer, T1. This transforms the 50-ohm output to a 12.5-ohm input to the final amplifier. C10 keeps the DC bias provided to Q3 by R6 and R9 isolated from the transformer.

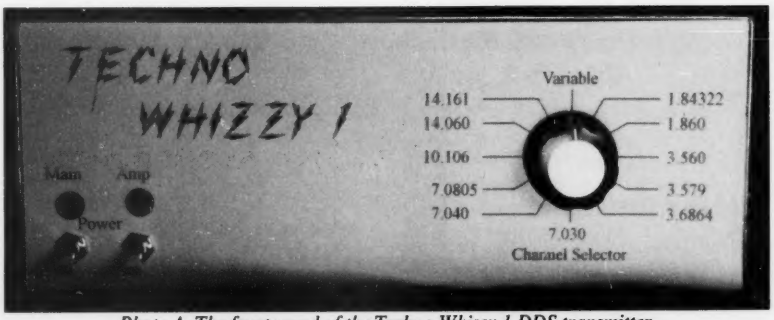


*Photo A. The front panel of the Techno-Whizzy 1 DDS transmitter.*

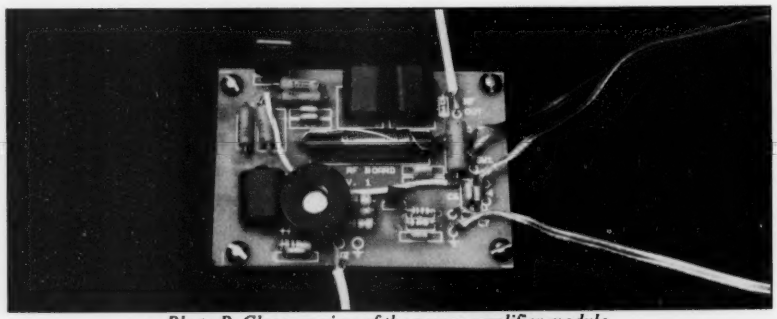

*Photo B. Close-up view of the power amplifier module.*

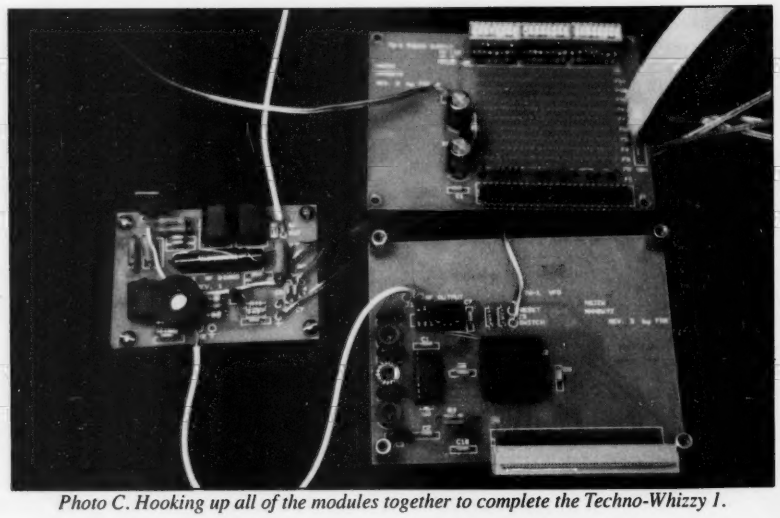

*Photo C. Hooking up all of the modules together to complete the Techno-Whizzy 1.*

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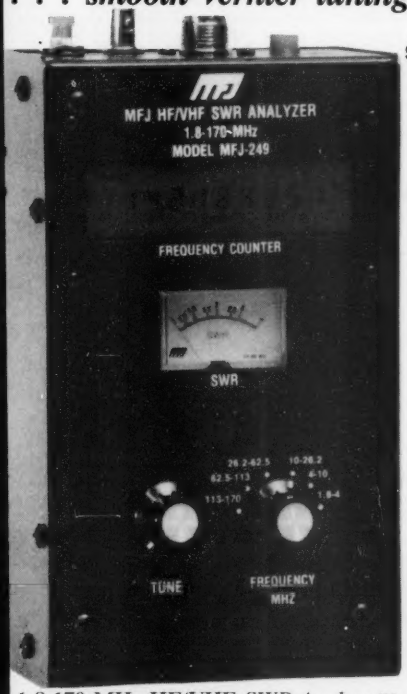


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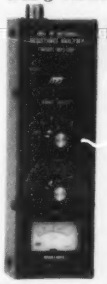

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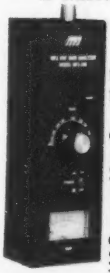

MFJ-208 **$79.95** **MFJ-208** 2 Meter VHF *SWR Analyzer*™ finds the SWR of any antenna from 138-156 MHz.

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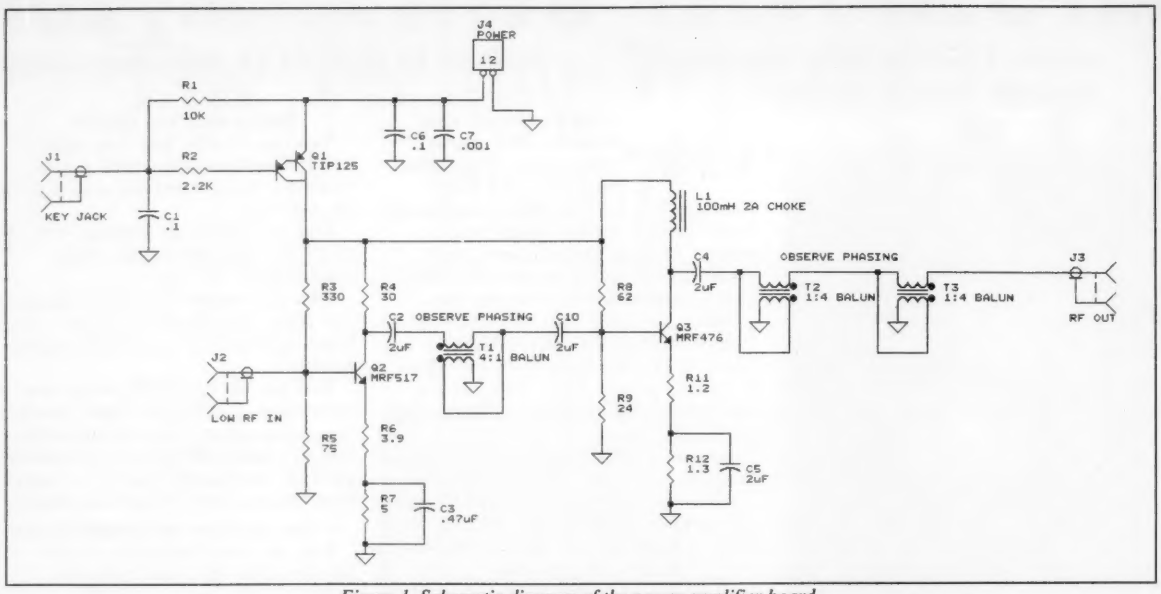


*Figure 1. Schematic diagram of the power amplifier board.*

Choke L1 provides power to the final amplifier, Q3. Emitter resistors R11 and R12 keep the final stable and provide limited output compensation with C5. The output flows through C4, into the 16:1 matching network of T2 and T3, then to the antenna connection at J3.

Power comes into the keying circuit through J4, the Transmit/Receive switch on the front panel. Capacitors C6 and C7 bypass RF to ground. The key is connected to jack J1. The unit is keyed by grounding Q1 through R2. R2 and C1 help in shaping the keying waveform, preventing sharp edges. Power to both the driver and final is keyed, keeping the power drain and associated heat to a minimum.

### Construction

The amplifier board should deliver about a watt of clean signal into a 50-ohm load. To do so will require you to wind some balun cores into transformers. There are three on this board, all 4:1 baluns using BN-43-202 cores. Winding them is a lot easier than explaining how, so take courage.

To wind the transformers, take about six feet of 30-gauge magnet wire and fold it in half. Putting one end in a vise, twist the wire to about 15 turns per inch (I used an electric screwdriver for this and it went very quickly). Wind this twisted wire up through the left hole of the balun core and back through the right. That's one turn. Go back in through the right and back out through the left, for two turns. Continue, winding eight to 12 turns on the core, leaving wires coming out of each hole at the bottom. Now cut the folded-over tip in the middle, making it two wires wrapped around each other.

Scrape back some insulation on the ends of the wire and use an ohmmeter as a continuity tester to identify the two wires. Twist the left-hand side of wire #1 to the right-hand side of wire #2. The left-hand side of wire #2 will go to ground, and the signal goes between the twist and the right-hand side of wire #1.

Now that you've got the transformers wound, install T1 on the board. Orient it so that the twisted end is in the middle, and one wire goes to ground and the other wire goes to Q2 (on the board, the "twisted" end is the two holes that are shorted together). This steps the 50-ohm output of Q2 down to 12.5 ohms into Q3.

Install the other two baluns at T2 and T3. Here again the twisted ends go in the middle, with one wire to ground and the other wire towards the output. These provide a 16:1 step up from the 3.125-ohm output at Q3 to 50 ohms at the antenna jack.

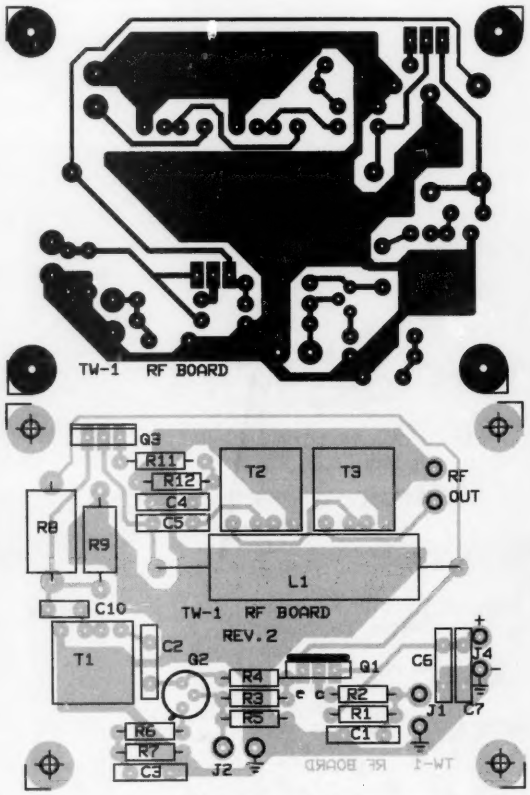


*Figure 2 (a). PC board foil pattern of the power amplifier board. (b). Parts placement.*

J1 is the input from your key. Hook this to a jack with a chunk of two-conductor wire or RG174 coax. J4 is the 12-volt power input. Hook this to a power input jack (if fused, use a 2-amp fuse). J2 is the RF output—attach this to the output jack (SO-239 preferred) with some more RG174. J3 is the RF input from the DDS VFO board—leave this vacant for now.

SW1 switches power from receive to transmit. As the amplifiers are class A, they consume a lot of power just sitting there. Leaving this stage powered down while receiving will cut the TW-1's power consumption to a trickle.

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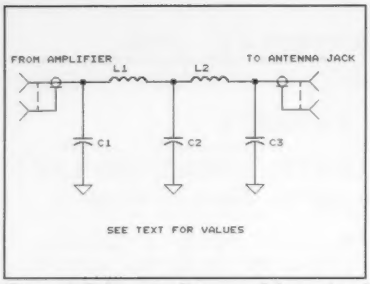


*Figure 3. Schematic diagram of the optional output filter board.*

Install the transistors next, matching the shapes to the shapes on the board to assure proper pin arrangement. Q1, the TIP125, shouldn't need any heat sink, but Q2 (an MRF517 or 2N3866) will—a top-hat type will be adequate. The MRF476, Q3, also needs to be heat-sinked, preferably to the back panel of the radio. Be sure to use thermal goop, a mica insulator and a nylon screw to attach this transistor to the case. For testing, you can use thermal goop and a TO220 heat sink, but don't run it for long!

By now you're almost done. Just install the rest of the parts. They're all passive components so there is no "backwards"—but be sure to get them in the right spots! As always, double-check your work.

Attach a dummy load (50 ohms 5 or more watts will work fine) to the SO-239 RF output connector. Turn SW1 to "transmit" to apply 12 volts to J4. Attach your voltmeter to the "hot" end of R5. With the key jack open, you shouldn't read more than 0.1 volt. With the key jack shorted, you should read around 2 volts. A small difference is

*Continued on page 85*

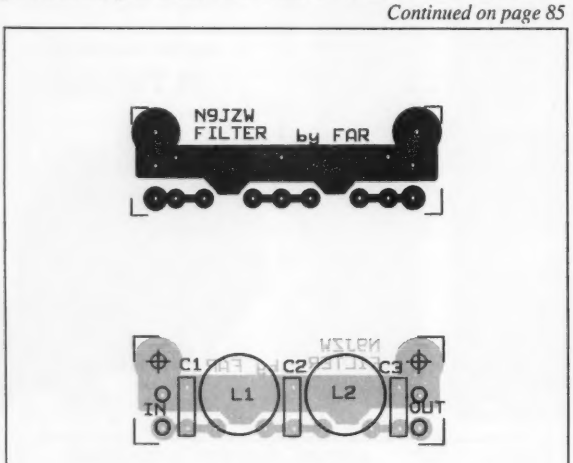


*Figure 4 (a). PC board foil pattern of the output filter board. (b). Parts placement.*

**Table 1.**

**Component Values for the 5-Pole Harmonic Output Filter**

| Band | C1,C3 | C2 | L1,L2 | Winding Information |
|---|---|---|---|---|
| 160m | 1000 pF | 2700 pF | 6.55 µH | 36 turns on a T50-2 toroid core |
| 80m | 470 pF | 1500 pF | 3.08 µH | 25 turns on a T50-2 toroid core |
| 40,30m | 220 pF | 560 pF | 1.19 µH | 17 turns on a T50-2 toroid core |
| 20,17,15m | 100 pF | 270 pF | 0.568 µH | 12 turns on a T50-2 toroid core |

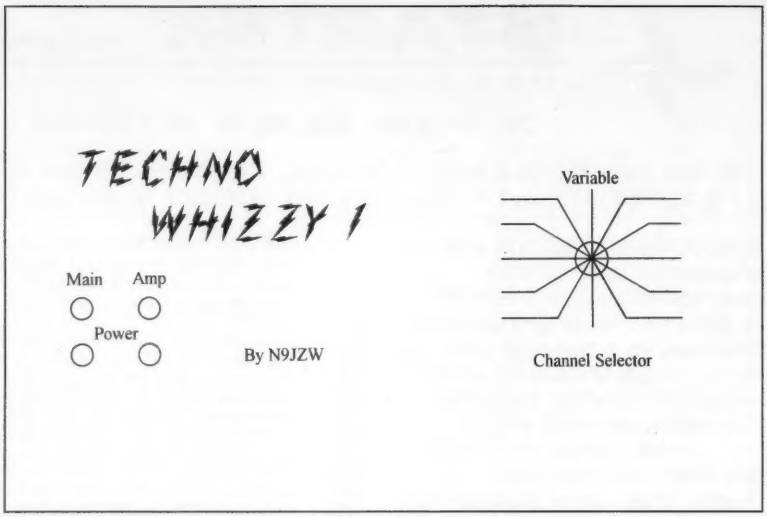


*Figure 5. Front panel pattern for the Techno-Whizzy 1. Blow up this figure with a copy machine to fit your cabinet.*

**Parts List: TW1 XMIT Linear Amplifier**

| Item | Quantity | Reference | Part | |
|---|---|---|---|---|
| 1 | 2 | C1,C6 | 0.1 µF | ceramic |
| 2 | 4 | C2,C4,C5,C10 | 2 µF | ceramic |
| 3 | 1 | C3 | 0.47 µF | ceramic |
| 4 | 1 | C7 | 0.001 µF | ceramic |
| 5 | 1 | J1 | key jack | |
| 6 | 1 | J2 | low RF in | |
| 7 | 1 | J3 | RF out to antenna | |
| 8 | 1 | J4 | power 12 volts in | |
| 9 | 1 | L1 | 100 mH 2A choke from Radio Shack | |
| 10 | 1 | Q1 | TIP125 | |
| 11 | 1 | Q2 | MRF517 or 2N3866 | |
| 12 | 1 | Q3 | MRF476 | |
| 13 | 1 | R1 | 10k ohm 1/4 watt | |
| 14 | 1 | R2 | 2.2k ohm 1/4 watt | |
| 15 | 1 | R3 | 330 ohm 1/4 watt | |
| 16 | 1 | R4 | 30 ohm 1/2 watt | |
| 17 | 1 | R5 | 75 ohm 1/2 watt | |
| 18 | 1 | R6 | 3.9 ohm 1/4 watt | |
| 19 | 1 | R7 | 5 ohm 1/4 watt (4.7 will work) | |
| 20 | 1 | R8 | 62 ohm 1 watt | |
| 21 | 1 | R9 | 24 ohm 1/2 watt | |
| 22 | 1 | R11 | 1.2 ohm 1 watt | |
| 23 | 1 | R12 | 1.3 ohm 1 watt | |
| 24 | 1 | SW1 | T/R switch DPDT toggle | |
| 25 | 3 | T1,T2,T3 | 4:1 balun on BN-43-202 core | |

Note: A complete kit of parts (including the PC boards) is available from Elktronics Northeast, Rt. 1 Box 789, Hancock NH 03449. Phone: (603) 525-4001. Prices as follows: *DDS VFO module* — $99; *Diode Matrix module* — $49; *Power Amplifier module* — $49; *Output Filter module (specify band)* — $10; A *complete package of all modules* — $199. The Qualcomm Q2220 DDS chip can be ordered separately for $39. All prices include postage.

Etched and drilled PC boards for this project are also available separately from FAR Circuits, 18N640 Field Court, Dundee IL 60118. Pricing: *DDS VFO PC board* — $8; *Diode Matrix PC board* — $8; *Power Amplifier board* — $6; *Output Filter* — $3. Please add $1.50 per order.

The Q2220 (as well as data sheets) is available directly from Qualcomm, 10555 Sorrento Valley Rd., San Diego CA 92121; (619) 597-5005. The price is $49 (1–24 qty.); $150 minimum order.

The CA3338A, the 55 MHz clock oscillator and most of the small parts are available from Digi-Key; (800) 344-4539.

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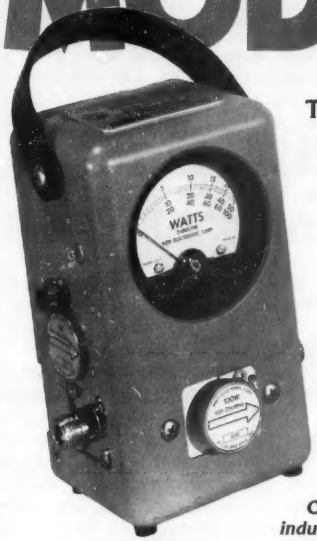
# MODEL 43



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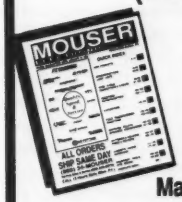


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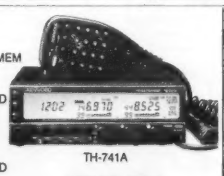


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# Programmable-Frequency Audio Generator

## *High accuracy with digital control.*

by Loyd W. Redman

Most audio signal generators built around IC timers or op amp oscillators require some external capacitors and resistors to determine oscillator frequency. To obtain high accuracy of an output frequency, the external capacitors need to be adjustable. If the oscillator is to have several frequency ranges, you'll need several external capacitors in addition to trimmers for fine frequency adjustments. Some capacitors change value with aging, so manual adjustments must be made each time the generator is used.

### Digital Audio Frequency Control

Micro Linear makes the ML2035 and the ML2036 IC sine wave generators needing only one external component, a crystal. The frequency is digitally controlled, so no external capacitors need to be adjusted to change frequency ranges or to fine-tune a selected frequency. Figure 1 shows the schematic of a programmable-frequency audio generator using either the ML2035 or the ML2036 ICs.

The heart of both the ML2035 and the ML2036 is a DAC (digital-to-analog converter). We enter a 16-bit digital word serially and get a sine wave output. Refer to Figure 2 and we'll review the operation of a simple DAC. The output directly from our basic DAC is not a nice smooth sine wave, but a triangle wave. The triangle wave is actually a series of voltage steps, not the smooth waveform we would see when an oscillator output is derived from the voltage at a capacitor terminal.

Here's how the voltage steps are generated. The circuit of Figure 2 can be viewed as an operational amplifier wired as an inverter, with separate digitally selectable input resistors. The voltage gain equation for an inverting op amp is: A=Rf/Rin. Our switches are SPST electronically controlled, solid-state switches. Suppose the digital control word contains four bits. We then have 16 possible output voltage steps. When the digital word is 0001, S4 is closed, connecting +10V to

*Continued on page 18*

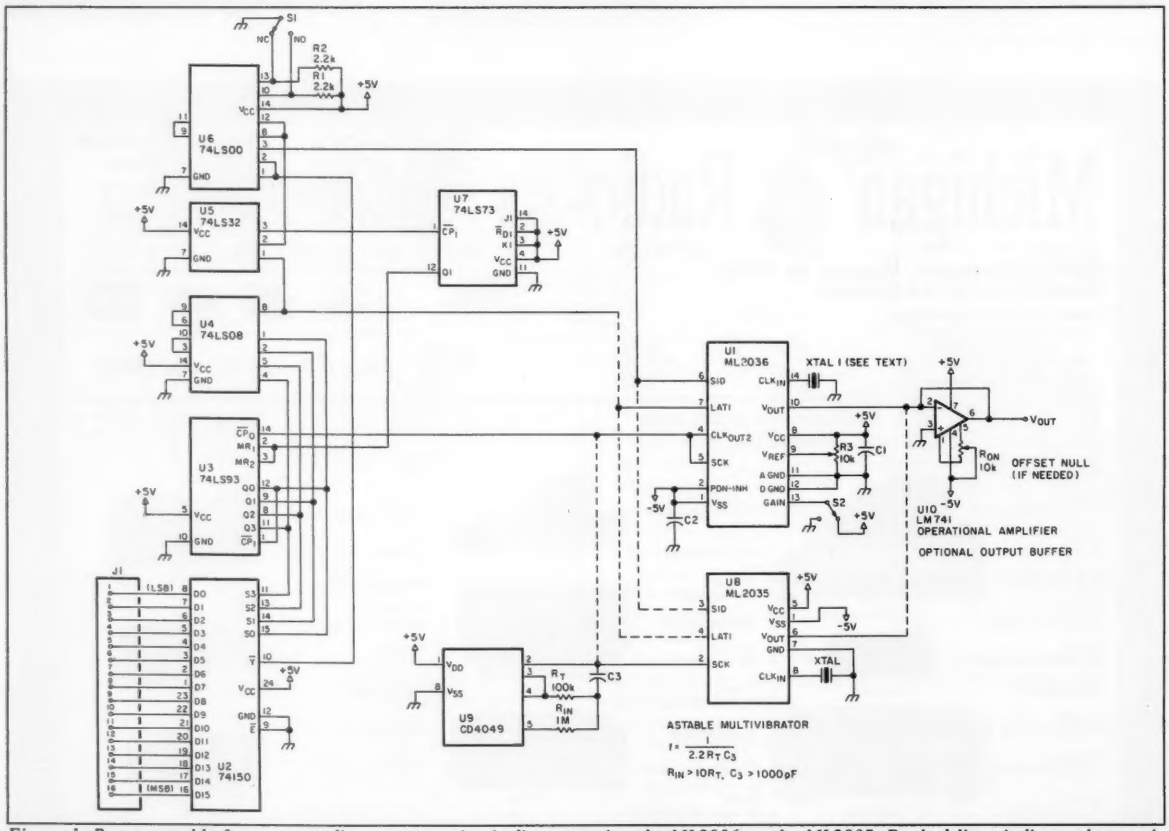


*Figure 1. Programmable-frequency audio generator circuit diagram using the ML2036 or the ML2035. Dashed lines indicate changes in wiring when using the ML2035.*

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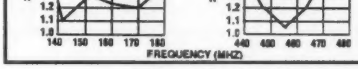


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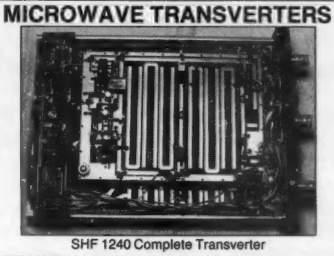

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## Programmable-Frequency Audio Generator

*Continued from page 16*

the end of the appropriate resistor in the network so the gain of U1, Rf/Rin, becomes 1/16 or 0.0625. The output voltage will be 0.0625 x 10V or 0.625V. Thus, the second output voltage step will be 1/16 of the reference voltage. If our up-counter begins at 0000, the 10V reference is not connected to U1, so the first voltage step is 0V. Our word generator continues to enter digital words in sequence to 1111. At a count of 1111, switches S1-S4 are closed, connecting resistors in the network to produce an amplifier gain of 0.9375 and an output voltage of 9.375V, 15/16 of the reference voltage.

At this point you may ask, "Where's the rest of the triangle wave?" With digital control words of 0000 to 1111, our output is only one quadrant of the triangle wave. Our control logic now directs the word generator to count down in the sequence 1111 to 0000. This will get our output steps back to 0V. Now we need to generate the negative-going half of the triangle wave. The sign bit from our word generator causes the control logic to change the position of S5, disconnecting the input to U2. The word generator counts up, then down, producing the negative-going alternation of our triangle wave.

If we apply an 8-bit digital control word and modify our switches and input resistors, we can produce an output voltage of 128 ($2^7$) steps. The 8th bit is used as the sign bit. We observe that the more voltage steps we have, the nearer the output of our DAC resembles a true triangle wave.

We could use a triangle wave as an audio test signal but the results wouldn't be as satisfactory as if we had used a true sine wave. Figure 3 shows a comparison of amplitudes between a triangle wave and a sine wave, one quadrant only. You can see that at an angle of about 55 degrees, the difference in amplitude between the two signals is about 2V.

The ML2035 and the ML2036 add two important blocks to our basic DAC that give us a near-ideal sine wave output. (Detailed spec sheets are available from Micro Linear, 2092 Concourse Drive, San Jose CA 95131.) The first of these functions is a sine look-up table. Remember back before the advent of hand-held calculators, when your math text contained tables of sine values for angles 0 degrees to 90 degrees? The sine look-up table is in the form of a read-only memory (ROM). The instantaneous value of the output voltage is derived from the value of the sine of an angle that is a multiple of 90/128, or about 0.703 degree. The output waveform is still a series of voltage steps. You can observe these steps with your 'scope if you operate the circuits with a clock input much slower than the recommended minimum of 3 MHz.

The second added block in our circuit appears just before the output. This block is a low-pass (smoothing) filter. Many of the internal functions of the ML2035 and the

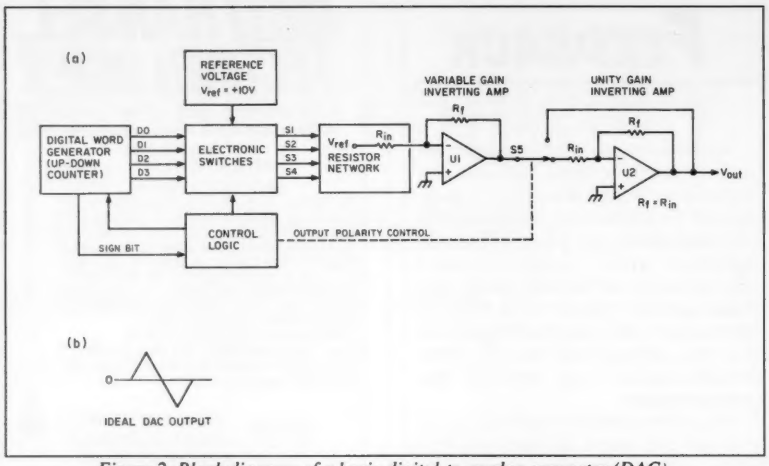


*Figure 2. Block diagram of a basic digital-to-analog converter (DAC).*

ML2036 operate at 1/4 clock frequency, 750 kHz, if our crystal is 3 MHz. Since we're interested in frequencies of 20 kHz or less, the low-pass filter removes most components of the higher frequency that are "straying" around in the close confines of our integrated circuits.

### How the Circuit Works

At initial power on, our circuit does nothing and we observe these conditions: The Q1 output of U7, a J-K flip-flop, is high. This high, connected to the master reset pins of U3, a 74LS93 4-bit binary counter, causes all the outputs of the counter to be low, 0000. With the master reset pins high, count is inhibited even though the 74LS93 is being clocked by the pulse train from pin 4 of the ML2036. The CLKout2 signal frequency is 1/8 our crystal frequency.

After we apply the 16-bit word to J1, circuit action is started by depressing and releasing S1. This sends a momentary high to one input of U5, a quad two-input OR gate, bringing pin 3 of U5 high, toggling U7. The Q1 output of U7 connected to the master reset pins of our counter goes low, enabling the 74LS93 to start counting.

Now that we have the circuit action start-

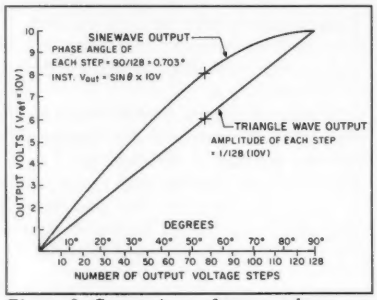
SINEWAVE OUTPUT
PHASE ANGLE OF EACH STEP = 90/128 = 0.703°
INST. Vout = SIN θ x 10V
TRIANGLE WAVE OUTPUT
AMPLITUDE OF EACH STEP = 1/128 (10V)
OUTPUT VOLTS (Vref = 10V)
DEGREES
10° 20° 30° 40° 50° 60° 70° 80° 90°
10 20 30 40 50 60 70 80 90 100 110 120 128
NUMBER OF OUTPUT VOLTAGE STEPS

*Figure 3. Comparison of one-quadrant output voltages from a DAC.*

ed, we'll describe how we use the ML2036 since it has several features that the ML 2035 does not have. The two main support circuits for the sine wave generator are U2, a 16-input multiplexer, and U3, a 4-bit binary counter. The frequency of the sine wave out of the ML2036 is determined by a 16-bit digital word serially clocked into pin 6, SID (serial input data).

The magnitude of this 16-bit value is determined by the equation: n(10)= (fout x $2^{23}$)/(fCLKin). If we use a 3 MHz crystal, this equation becomes: n(10)=

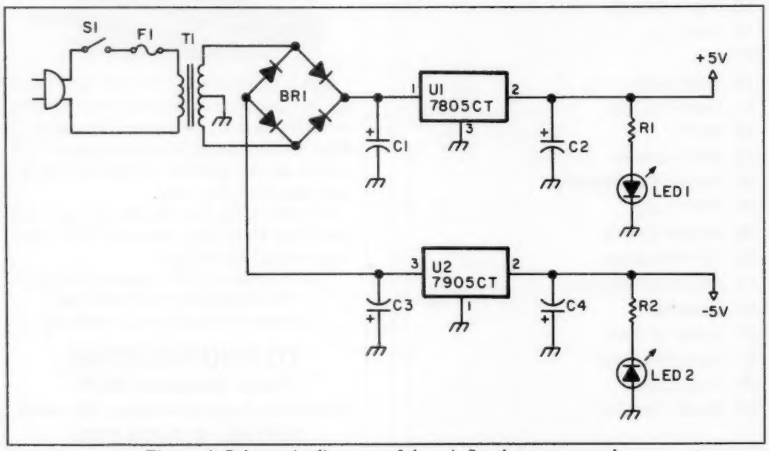


*Figure 4. Schematic diagram of the +/- 5 volt power supply.*

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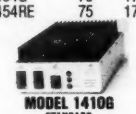
| 0508G | 1 | 170 | 28 | 15/0.6 | Standard |
| 0508R | 1 | 170 | 28 | –/– | Repeater |
| 0510G | 10 | 170 | 25 | 15/0.6 | Standard |
| 0510R | 10 | 170 | 25 | –/– | Repeater |
| 0550G | 5-10 | 375 | 60 | 15/0.6 | HPA |
| 0550RH | 5-10 | 375 | 60 | –/– | Repeater HPA |
| 0552G | 25-40 | 375 | 55 | 15/0.6 | HPA |
| 0552RH | 25-40 | 375 | 55 | –/– | Repeater HPA |
| **144 MHz** | | | | | |
| 1403G | 1-5 | 10-50 | 6 | 15/0.6 | LPA |
| 1406G | 25 | 100 | 12 | 15/0.6 | Standard |
| 1409G | 2 | 150 | 25 | 15/0.6 | Standard |
| 1409R | 2 | 150 | 24 | –/– | Repeater |
| 1410G | 10 | 160 | 25 | 15/0.6 | Standard |
| 1410R | 10 | 160 | 24 | –/– | Repeater |
| 1412G | 25-45 | 160 | 20 | 15/0.6 | Standard |
| 1412R | 25-45 | 160 | 19 | –/– | Repeater |
| 1450G | 5 | 350 | 56 | 15/0.6 | HPA |
| 1450RH | 5 | 350 | 56 | –/– | Repeater HPA |
| 1452G | 25 | 350 | 50 | 15/0.6 | HPA |
| 1452RH | 25 | 350 | 50 | –/– | Repeater HPA |
| 1454G | 50-100 | 350 | 40 | 15/0.6 | HPA |
| 1454RH | 50-100 | 350 | 40 | –/– | Repeater HPA |
| **220 MHz** | | | | | |
| 2203G | 1-5 | 10-40 | 6 | 14/0.7 | LPA |
| 2210G | 10 | 130 | 20 | 14/0.7 | Standard |
| 2210R | 10 | 130 | 19 | –/– | Repeater |
| 2212G | 30 | 130 | 16 | 14/0.7 | Standard |
| 2212R | 30 | 130 | 15 | –/– | Repeater |
| 2250G | 5 | 220 | 40 | 14/0.7 | HPA |
| 2250RH | 5 | 250 | 40 | –/– | Repeater HPA |
| 2252G | 25 | 220 | 36 | 14/0.7 | HPA |
| 2252RH | 25 | 250 | 36 | –/– | Repeater HPA |
| 2254G | 75 | 220 | 32 | 14/07 | HPA |
| 2254RH | 75 | 250 | 32 | –/– | Repeater HPA |
| **440 MHz** | | | | | |
| 4403G | 1-5 | 7-25 | 4 | 12/1.1 | LPA |
| 4410G | 10 | 100 | 19 | 12/1.1 | Standard |
| 4410R | 10 | 100 | 18 | –/– | Repeater |
| 4412G | 20-30 | 100 | 19 | 12/1.1 | Standard |
| 4412R | 20-30 | 100 | 18 | –/– | Repeater |
| 4448G | 5 | 100 | 22 | 12/1.1 | HPA |
| 4448R | 5 | 100 | 22 | –/– | Repeater HPA |
| 4450G | 5-10 | 175 | 34 | 12/1.1 | HPA |
| 4450RE | 5-10 | 175 | 34 | –/– | Repeater HPA |
| 4452G | 25 | 175 | 29 | 12/1.1 | HPA |
| 4452RE | 25 | 175 | 29 | –/– | Repeater HPA |
| 4454G | 75 | 175 | 25 | 12/1.1 | HPA |
| 4454RE | 75 | 175 | 25 | –/– | Repeater HPA |



**MODEL 1410G**
STANDARD

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| 220 MHz | 2220B | .5 | 22 | BNC |
| 220 MHz | 2220N | .5 | 22 | N |
| 440 MHz | 4420B | .5 | 18 | GNC |
| 440 MHz | 4420N | .5 | 18 | N |
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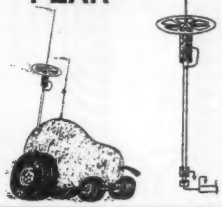

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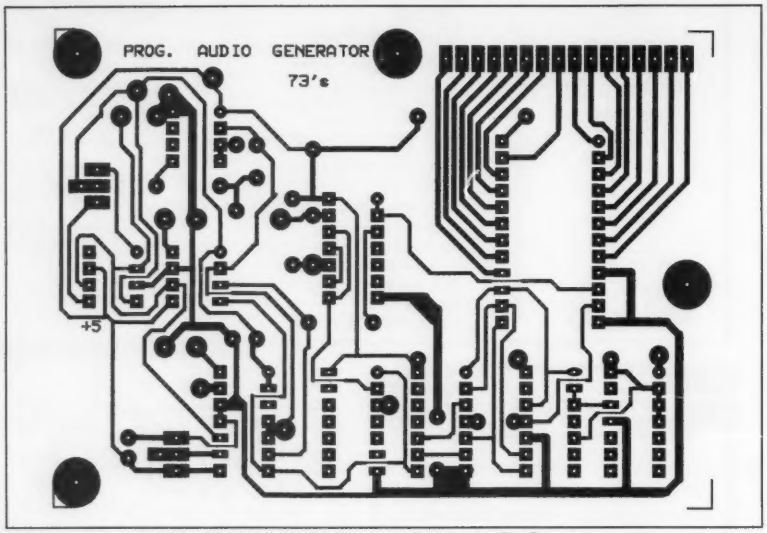


*Figure 5. PC board foil pattern for the Audio Generator.*

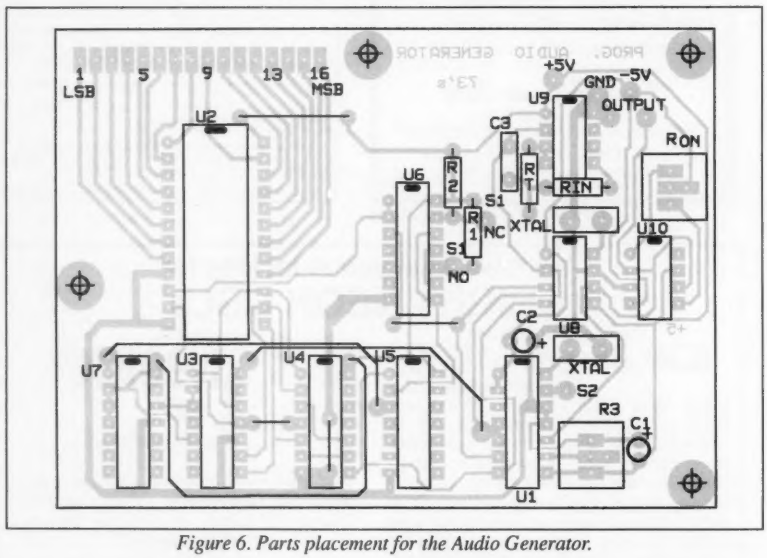


*Figure 6. Parts placement for the Audio Generator.*

(8,388,608 x fout)/3,000,000=2.7962 x fout. This gives a decimal (base 10) number which must be changed to digital (binary) form. The circuit builder has a variety of methods to apply the digital word to J1 and subsequently to the inputs of the 74150; 16 SPDT switches, 16 DIP switches, or a 16-key keypad encoder. The 74150 can be visualized as a 16-position rotary switch. When started, the 74LS93 counter counts 0000-to-1111, selecting in turn each of the 16 inputs to the multiplexer, LSB (least significant bit) first.

Since the output of the multiplexer is the inverted form of the input bit, we route the inverted bits through one gate of U6, a quad, two-input NAND gate, on to the SID (serial data) input of the ML2036. Each of the 16 bits must be individually clocked into the ML2036 before the 74150 switches to the next bit. Pin 4 of the ML2036 gives us a pulse train at frequency of CLKin/8. We use these pulses to clock the counter (on the high-to-low transition). Note that the CLKin/8 signal is also connected to the pin 5, SCK (serial clock) input. The rising edge of this signal clocks in the bit selected by the multiplexer. After the 74LS93 has counted to 1111, clocking in all the 16 bits, the entire word must be latched by a falling edge applied to pin 7, LATI (serial latch). This falling edge latch signal is derived by feeding the counter outputs to two gates of U4, a 74LS08 quad two-input AND gate. The 74LS08 serves effectively as a four-input AND gate. Until the 74LS93 count reaches 1111, pin 8 of the 74LS08 is low. When pin 8 goes high at count 1111, pin 7 of the ML2036 goes high. This high is also fed to a gate of U5, a 74LS32 quad two-input OR gate. Pin 3 of the 74LS32 goes high, "toggling" U7, a 74LS73 J-K flip-flop. The Q1 output of the 74LS73 is connected to the master reset inputs of the counter, bringing them high and clearing the counter outputs to 0000. As long as the master reset inputs are high, the counter will not count. With all the counter outputs at 0000, pin 8 of our 74LS08, and subsequently the signal at the LATI input to the ML2036, go low, latching in the 16-bit word. At this latching, the sine wave output appears at pin 10 of the ML2036.

Figure 1 shows our ML2036 with all the bells and whistles attached. S2 provides a logic high or low to pin 13, the GAIN input. When pin 13 is high, the output sine wave peak amplitude is plus or minus VREF. When pin 13 is low, the peak output amplitude is plus or minus VREF/2. R3 provides a variable voltage at pin 9, VREF. If a variable VREF is not desired, we tie pin 9 directly to +5V. Our circuit shows pin 2, PDN-INH (power down-inhibit), tied directly to -5V. *[Ed. Note: You can use the +/- 5 volt supply shown in Figure 4 to power the Audio Generator.]* In this configuration, when we want the ML2036 to stop generating an output, we simply shift in a 16-bit word of all zeros.

The dashed lines in Figure 1 show the modifications to the circuit when the ML2035 is used. The main difference between the two circuits is that we use a CMOS hex inverter wired as an astable multivibrator to furnish a clock input to the 74LS93 and the serial clock signal to pin 2 of the ML2035.

The circuit builder can't go wrong by including an external buffer at the output of either circuit. The specified output drive capability is a 1k, 100 pF load. I used the ML2036 output directly into the auxiliary input of an audio tape recorder with satisfactory results. I used a 0.5V p-p sine wave, amplitude adjusted with R3. The LM741 operational amplifier makes a suitable output buffer for audio frequencies.

**Construction**

Construction methods are the circuit builder's choice. I assembled the circuit temporarily on modular breadboard sockets similar to Radio Shack 276-174. I use 22-gauge jumper wires between IC pins. After building the circuit and verifying operation, I then make a permanent assembly on Radio Shack's matching PC board, 276-170. I prefer to use wire-wrap for final connections. Refer to the master wire list and use a continuity checker to verify correct wiring before installing the ICs. Lead dress does not appear to be critical. In the temporary version of the circuit, I used a 12 MHz crystal with untrimmed (1-1/2") leads and connected the CLKout1 pin (6 MHz) to the 74LS93. However, the crystal should be placed physically as close as possible to the CLK in pin. Unless your power supply is on the same PC board as the rest of the circuit, you should bypass the +5V and -5V connections to the ML2036 with 0.1 µF ceramic disc capacitors. *[Ed. Note: PC boards are available for the Audio Generator and the +/- 5 volt supply board (see the Parts List for details).]*

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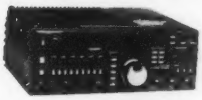

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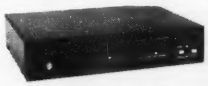

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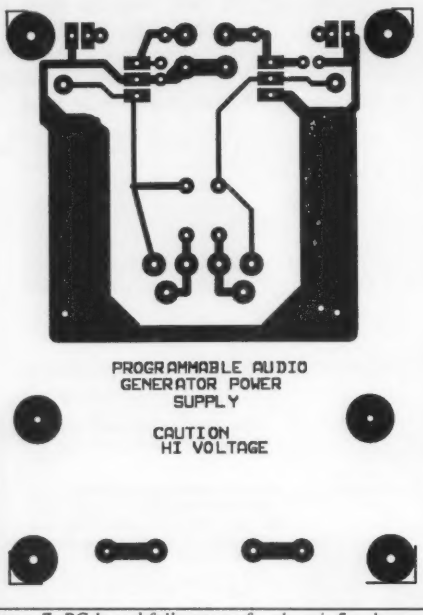


*Figure 7. PC board foil pattern for the +/- 5 volt power supply.*

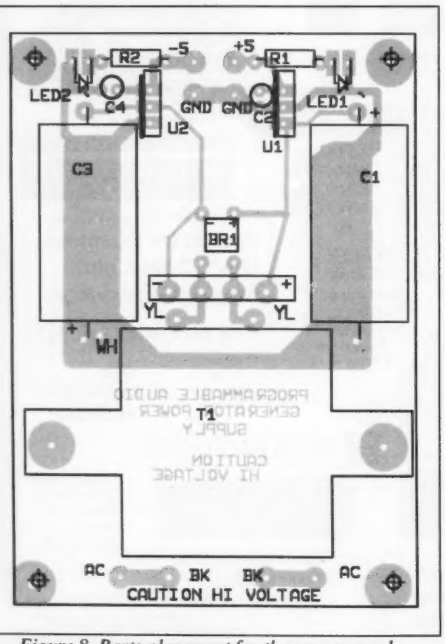


*Figure 8. Parts placement for the power supply.*

## Parts List

*Audio Generator*

| | |
|---|---|
| U1 | ML2036 programmable sine wave generator |
| U2 | 74150 16-input multiplexer |
| U3 | 74LS93 4-bit binary ripple counter |
| U4 | 74LS08 quad, 2-input AND gate |
| U5 | 74LS32 quad, 2-input OR gate |
| U6 | 74LS00 quad, 2-input NAND gate |
| U7 | 74LS73 dual JK flip-flop |
| U8 | ML2035 programmable sinewave generator |
| U9 | CD4049 hex inverting buffer |
| Y1 | Crystal 3 MHz to 12.4 MHz (see text) |
| R1,R2 | 2.2k, 1/4 W, 5% |
| R3 | 10k potentiometer |
| RT | (see text) |
| Rin | (see text) |
| C1,C2 | 0.1 µF ceramic-disc capacitor |
| C3 | (see freq. equation for U9) |
| S1 | SPDT momentary switch |
| S2 | SPDT switch |
| PC board | See Note 2 |

Misc: Perfboard materials, IC sockets, wire, solder, enclosure, hardware, etc.

*Power supply parts list.*

| | | |
|---|---|---|
| S1 | SPST switch, 6A @ 125V | RS# 275-634 |
| F1 | Fuse, fast acting, 500 mA | RS# 270-1271 |
| T1 | Power transformer, 12.6 VCT, 450 mA | RS# 273-1365 |
| BR1 | Bridge rectifier 1A @ 50 PIV | RS# 276-1161 or 276-1146 |
| U1 | 7805CT, +5V voltage regulator | RS# 276-1770 |
| U2 | 7905CT, -5V voltage regulator | (See Note 1) |
| C1,C3 | 2200 µF/35V electrolytic capacitor | RS#272-1020 |
| C2 | 0.1 µF/35V tantalum capacitor | RS# 272-1432 |
| C4 | 1.0 µF/35V tantalum capacitor | RS# 272-1434 |
| R1,R2 | 330 ohm carbon film resistors, 1/4W, 5% | RS# 271-1315 |
| LED1,LED2 | Light emitting diodes | RS#276-041 |
| PC board | See Note 1 | |

Note 1: The 7905 type -5 volt regulator is not normally stocked by Radio Shack but can be special ordered from them. It's also generally stocked by most mail order houses.

Note 2: Etched and drilled PC boards are available from FAR Circuits, 18N640 Field Court, Dundee IL 60118. The Audio Generator board is $6 and the +/- 5 volt power supply board is $5. Please add $1.50 per order for postage.

Note 3: Micro Linear spec sheets and a distributor list are available from Micro Linear, 2092 Concourse Drive, San Jose CA 95131. Phone: (408) 433-5200. Three of the distributors are:

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### Checkout

The minimum requirement of instruments needed for checkout is a logic probe or DC voltmeter, and some form of a simple audio amplifier. If you want to go first class you can also use a 'scope and frequency counter.

This checkout procedure applies to the ML2036-based circuit. First, open the short between pin 4 and 5 of the ML2036. Then open the lead between pin 4 of the ML2036 and pin 14 of the 74LS93. Next, connect a 330 ohm current limiting resistor and a LED to each of the four 74LS93 outputs Q0-Q3. The anode of each LED is connected to the resistor and the cathode is connected to ground.

Fabricate a bounceless push-button switch similar to S1 in our complete circuit. Connect the momentary switch and resistors so the output goes low-to-high when the switch is depressed. Connect the output of this switch to pin 14 of the 74LS93 and pin 5 of the ML2036. Now turn on the power and apply a 16-bit word to the 74150. If you're using an audio amplier to verify the sine wave generator operation, select a 16-bit word to produce a frequency you can hear.

Depress and release S1 to "toggle" flip-flop U7 and enable the 74LS93. You will observe that all the LEDs are off, indicating a count of 0000 which shows us that switch position 0 (LSB) of the 74150 is selected. Now depress the bounceless push-button you have connected to pin 14 of the 74LS93. The low-to-high transition of the output will clock in the LSB of our 16-bit word. When you release the bounceless push-button, the high-to-low transition of the output will clock the 74LS93 and the LEDs will indicate a count of 0001. Continue operating the switch until you observe the LEDs indicate a count of 1111. Depressing the push-button one more time will clock in the MSB (most significant bit) and releasing it will cause the 74LS93 count to show 0000, bringing the reset inputs high and latching in the 16-bit word. The ML2036 should now be generating the desired frequency.

After you have verified proper operation of the circuit, disconnect the LEDs and current-limiting resistors. Disconnect your temporary push-button switch and replace the short between pins 4 and 5 of the ML2036. Finally, replace the connection between pin 4 of the ML2036 and pin 14 of U3. Your circuit is now ready to be used as an audio frequency test generator.

*See Table 1 on page 30*

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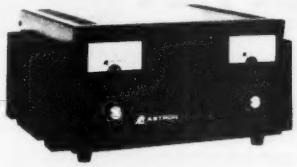

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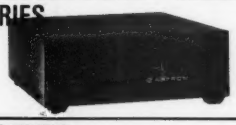
- All units available in 220 VAC input voltage (except for SL-11A)

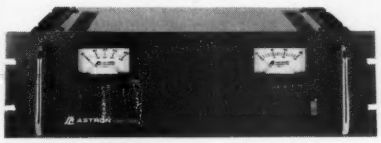
## SL SERIES



| MODEL | Colors Gray | Colors Black | Continuous Duty (Amps) | ICS* (Amps) | Size (IN) H × W × D | Shipping Wt. (lbs.) |
|---|---|---|---|---|---|---|
| • LOW PROFILE POWER SUPPLY | | | | | | |
| SL-11A | • | • | 7 | 11 | 2¾ x 7⅝ x 9¾ | 11 |

## RS-L SERIES

| MODEL | Continuous Duty (Amps) | ICS* (Amps) | Size (IN) H × W × D | Shipping Wt. (lbs.) |
|---|---|---|---|---|
| • POWER SUPPLIES WITH BUILT IN CIGARETTE LIGHTER RECEPTACLE | | | | |
| RS-4L | 3 | 4 | 3½ x 6⅛ x 7¼ | 6 |
| RS-5L | 4 | 5 | 3½ x 6⅛ x 7¼ | 7 |

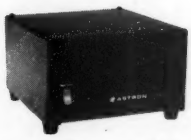


## RM SERIES

MODEL RM-35M

| • 19" RACK MOUNT POWER SUPPLIES MODEL | Continuous Duty (Amps) | ICS* (Amps) | Size (IN) H × W × D | Shipping Wt. (lbs.) |
|---|---|---|---|---|
| RM-12A | 9 | 12 | 5¼ × 19 × 8¼ | 16 |
| RM-35A | 25 | 35 | 5¼ × 19 × 12½ | 38 |
| RM-50A | 37 | 50 | 5¼ × 19 × 12½ | 50 |
| RM-60A | 50 | 55 | 7 × 19 × 12½ | 60 |
| • Separate Volt and Amp Meters | | | | |
| RM-12M | 9 | 12 | 5¼ × 19 × 8¼ | 16 |
| RM-35M | 25 | 35 | 5¼ × 19 × 12½ | 38 |
| RM-50M | 37 | 50 | 5¼ × 19 × 12½ | 50 |
| RM-60M | 50 | 55 | 7 × 19 × 12½ | 60 |

## RS-A SERIES



MODEL RS-7A

| MODEL | Colors Gray | Colors Black | Continuous Duty (Amps) | ICS* (Amps) | Size (IN) H × W × D | Shipping Wt. (lbs.) |
|---|---|---|---|---|---|---|
| RS-3A | | • | 2.5 | 3 | 3 × 4¾ × 5¾ | 4 |
| RS-4A | • | • | 3 | 4 | 3¾ × 6½ × 9 | 5 |
| RS-5A | | • | 4 | 5 | 3½ × 6⅛ × 7¼ | 7 |
| RS-7A | • | • | 5 | 7 | 3¾ × 6½ × 9 | 9 |
| RS-7B | • | • | 5 | 7 | 4 × 7½ × 10¾ | 10 |
| RS-10A | • | • | 7.5 | 10 | 4 × 7½ × 10¾ | 11 |
| RS-12A | • | • | 9 | 12 | 4½ × 8 × 9 | 13 |
| RS-12B | | • | 9 | 12 | 4 × 7½ × 10¾ | 13 |
| RS-20A | • | • | 16 | 20 | 5 × 9 × 10½ | 18 |
| RS-35A | • | • | 25 | 35 | 5 × 11 × 11 | 27 |
| RS-50A | • | | 37 | 50 | 6 × 13¾ × 11 | 46 |

## RS-M SERIES

MODEL RS-35M

| MODEL | Continuous Duty (Amps) | ICS* (Amps) | Size (IN) H × W × D | Shipping Wt. (lbs.) |
|---|---|---|---|---|
| • Switchable volt and Amp meter | | | | |
| RS-12M | 9 | 12 | 4½ × 8 × 9 | 13 |
| • Separate volt and Amp meters | | | | |
| RS-20M | 16 | 20 | 5 × 9 × 10½ | 18 |
| RS-35M | 25 | 35 | 5 × 11 × 11 | 27 |
| RS-50M | 37 | 50 | 6 × 13¾ × 11 | 46 |

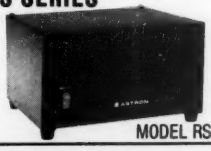
## VS-M AND VRM-M SERIES

MODEL VS-35M

• Separate Volt and Amp Meters • Output Voltage adjustable from 2-15 volts • Current limit adjustable from 1.5 amps to Full Load

| MODEL | Continuous Duty (Amps) @13.8VDC | @10VDC | @5VDC | ICS* (Amps) @13.8V | Size (IN) H × W × D | Shipping Wt. (lbs.) |
|---|---|---|---|---|---|---|
| VS-12M | 9 | 5 | 2 | 12 | 4½ × 8 × 9 | 13 |
| VS-20M | 16 | 9 | 4 | 20 | 5 × 9 × 10½ | 20 |
| VS-35M | 25 | 15 | 7 | 35 | 5 × 11 × 11 | 29 |
| VS-50M | 37 | 22 | 10 | 50 | 6 × 13¾ × 11 | 46 |
| • Variable rack mount power supplies | | | | | | |
| VRM-35M | 25 | 15 | 7 | 35 | 5¼ × 19 × 12½ | 38 |
| VRM-50M | 37 | 22 | 10 | 50 | 5¼ × 19 × 12½ | 50 |

## RS-S SERIES



MODEL RS-12S

• Built in speaker

| MODEL | Colors Gray | Colors Black | Continuous Duty (Amps) | ICS* Amps | Size (IN) H × W × D | Shipping Wt. (lbs.) |
|---|---|---|---|---|---|---|
| RS-7S | • | • | 5 | 7 | 4 × 7½ × 10¾ | 10 |
| RS-10S | • | • | 7.5 | 10 | 4 × 7½ × 10¾ | 12 |
| RS-12S | • | • | 9 | 12 | 4½ × 8 × 9 | 13 |
| RS-20S | • | • | 16 | 20 | 5 × 9 × 10½ | 18 |

*ICS—Intermittent Communication Service (50% Duty Cycle 5min. on 5 min. off)

CIRCLE 16 ON READER SERVICE CARD

# The SP-1 Transceiver

## *Build the HF "Spider."*

by Mike Agsten WA8TXT

The idea of bringing ham radio along on a wilderness jaunt has strong initial appeal, but when the details are itemized it becomes apparent that sheer weight and volume will displace the truly essential needs like drinking water, food, and raiment.

Let's see . . . I'll take the back-up transceiver, deep-cycle trolling battery, wattmeter, antenna tuner, memory keyer, headphones, wire, coax cable . . . wait a minute! Is this Field Day, or a camping trip?

While I don't mind exposing myself to the great outdoors, even the back-up transceiver has considerable monetary value (and weighs a ton!). No; what I need is a rough-and-ready rig. Something so inexpensive that it could almost be considered a "throwaway."

### The "Spider" Solution

The SP-1 Spider is designed to fit this bill. I've nicknamed it after our friend the arachnid because, in ordinary operation, you plug in a crystal and wait, patiently if necessary, for your next victim to arrive on frequency! For wilderness skeds, the gang back home is well accustomed to digging weak signals from the noise, but in case they've exaggerated their radio prowess, I've allowed one full watt of transmitter power: perfect for a battery of "AA" cells. At home they can adjust power as needed, so the SP-1 receiver section is nothing special: a direct-conversion mixer and IC audio amplifier. Provision for an audio bandpass filter is included.

A well-designed VFO may be drift-free at home, but in the ever-changing outdoors, crystals are far more predictable, especially in this category of simple equipment. As presented, the Spider holds two switch-selectable FT-243 type crystals, though other arrangements are possible. A single HC-18 wire-lead crystal, for example, can be installed directly on the PC board, or a rotary-switched bank of them might replace the octal socket used here.

It's a bit preposterous to carry accessories bigger than the rig itself, so I've included a built-in telegraph key and, instead of visual output indication, a "smart-tone." This circuit monitors RF output and varies the sending sidetone pitch accordingly. You can be sure you're on the air if you hear "good tone" when you close the key, so leave the wattmeter at home!

Portable operation isn't the only possibility for this rig. It should work even better with the well-deployed sky hooks in your back yard. And if you find a prospective Novice interested in telegraphy, it might make a great loaner. Disable the transmitter and you've got, essentially, a code practice set with a built-in receiver.

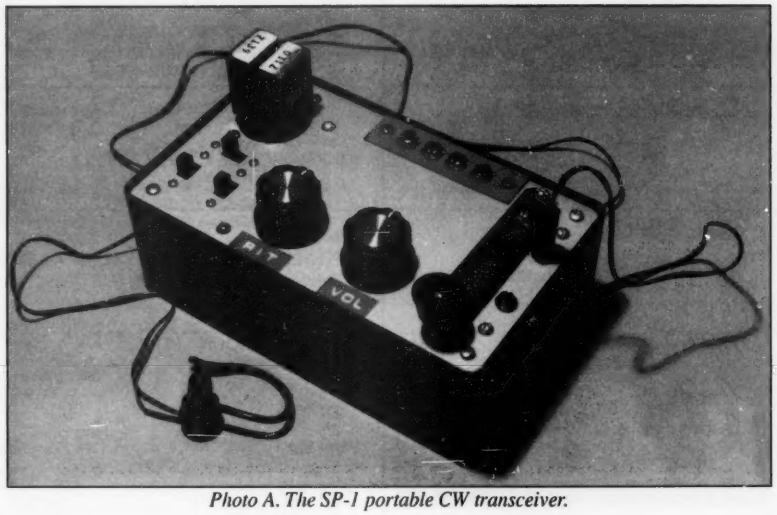



*Photo A. The SP-1 portable CW transceiver.*

### Circuit Description

If you judge a circuit's simplicity by transistor count alone, the SP-1 may appear more complex than necessary to fill the needs listed here. But, most generic transistors cost little more than capacitors so I tend to use them with impunity wherever the need to "transfer resistance" occurs, and let the chips fall where they may. Q3 (see Figure 1) is one example of this approach. It's not essential but it does allow you to operate oscillator Q1 at reduced current drain during receive (a battery-saving feature) without sacrificing drive to final amplifier Q2 on transmit. During receive, Q4 prevents the emitter-base junction of Q2 from otherwise clipping the oscillator waveform, which may lead to undesired receiver responses. It also provides a handy place for leading-edge envelope shaping with R9, R10 and C8.

During receive, incoming signals pass through L3, L2, C15 and C19 to receiver-tuned circuit T2/C25 and gate 1 of mixer Q7. With the oscillator signal via C18 present at gate 2, Q7 produces the desired audio beat note which proceeds through volume control R31 to audio amplifier U1. This LM386 IC provides enough power gain to drive a small loudspeaker at home, or ear buds or headphones in the field. Should you desire an audio bandpass filter, insert it in place of wire jumper W3. Receiver fine-tuning is accomplished by varying the tuning voltage on D1 with RIT control R32.

Automatic T/R switching (QSK) begins at key closure. Q8 switches on, rapidly energizing the 12T bus. 12T, the master control signal in this rig, switches many circuits. Let's take a look at each, in case you need to troubleshoot. D4, via R11, turns on to protect the receiver input. Q5 turns on and, by grounding D1 tuning voltage, frequency shifts oscillator Q1 down about 1 kHz, the actual amount depending on band and L1 inductance.

Q6 mutes the receiver audio while sidetone from Q9 and level adjustment R22 takes over the audio channel. Q4 turns on and keys RF power amplifier Q2. Transmitter RF is routed through low-pass filter L2/L3 to the antenna terminal, and via C16 to RF detector D3. The output level detected by D3 controls Q10 conduction which, in turn, varies the program voltage to Q9, with a programmable unijunction transistor used here to generate sidetone. Full RF output cuts off Q10, raising Q9's program voltage and lowering its output frequency to the normal pitch. This "smart-tone" action is far from linear but still very useful. A dying battery, for instance, will produce a rising sidetone pitch when the key is held down (time to revert to smoke signals or a message in a bottle!). Upon key release, C27 shapes the trailing edge and Q6 with C20 covers up the receive-recovery pop.

### Construction

In the top view photograph of the Spider, you can see the octal crystal socket in the left-rear corner. Crystal select switch S2 is just in front. TB1, a four-lug terminal board, mounts along the rear of the top panel. Its terminals are numbered 1 to 4, going from left to right. Connections are DC power to 1 (+) and 2 (-) and antenna system to 3 (ground) and 4 (hot). Along the right edge are 3.5 mm jacks for

# RAMSEY ELECTRONICS

## COM-3
**$2995⁰⁰**

### 2 WAY RADIO SERVICE MONITOR

COM-3, the world's most popular low-cost service monitor. For shops big or small, the COM-3 delivers advanced capabilities for a fantatic price—and our new lease program allows you to own a COM-3 for less than $3.00 a day. Features •Direct entry keyboard with programmable memory •Audio & transmitter frequency counter •LED bar graph frequency/error deviation display •0.1–10.000 µV output levels •High receive sensitivity, less than 5 µV •100 kHz to 999.9995 MHz •Continuous frequency coverage •Transmit protection, up to 100 watts •CTS tone encoder, 1 kHz and external modulation.

## RSG-10
**$2495⁰⁰**

### SYNTHESIZED SIGNAL GENERATOR

Finally, a low-cost lab quality signal generator—a true alternative to the $7,000 generators. The RSG-10 is a hard working, but easy to use generator ideal for the lab as well as for production test. Lease it for less than $3.00 a day. Features •100 kHz to 999 MHz •100 Hz resolution to 500 MHz, 200 Hz above • – 130 to + 10 dBm output range •0.1 dB output resolution •AM and FM modulation •20 programmable memories •Output selection in volts, dB, dBm with instant conversion between units •RF output reverse power protected •LED display of all parameters—no analog guesswork!

## FREQUENCY COUNTERS

**CT-70 7 DIGIT 525 MHz** | **CT-90 9 DIGIT 600 MHz** | **CT-125 9 DIGIT 1.2 GHz**

Ramsey Electronics has been manufacturing electronic test gear for over 10 years and is recognized for its lab quality products at breakthrough prices. All of our counters carry a full one-year warranty on parts and labor. We take great pride in being the largest manufacturer of low-cost counters in the entire U.S.A. Compare specifications. Our counters are full-featured, from audio to UHF, with FET high impedance input, proper wave shaping circuitry, and durable high quality epoxy glass plated-thru PC board construction. All units are 100% manufactured in the U.S.A. All counters feature 1.0 ppm accuracy.

**NEW CT-250 2.5 GHZ**

### ACCESSORIES FOR COUNTERS

| | |
|---|---|
| Telescopic ship antenna—BNC plug, WA-10 | $11.95 |
| High impedance probe, light loading, HP-1 | $16.95 |
| Low-pass probe, audio use, LP-1 | $16.95 |
| Direct probe, general purpose use, DC-1 | $16.95 |
| Tilt bail, elevates counter for easy viewing, TB-70 | $9.95 |
| Rechargeable internal battery pack, BP-4 | $8.95 |
| CT-90 oven timebase, 0.1 ppm accuracy, OV-1 | 59.95 |

### ALL COUNTERS ARE FULLY WIRED & TESTED

| MODEL | FREQ. RANGE | SENSITIVITY | DIGITS | RESOLUTION | PRICE |
|---|---|---|---|---|---|
| CT-50 | 20 Hz–600 MHz | < 25 mV to 500 MHz | 8 | 1 Hz, 10 Hz | $189.95 |
| CT-70 | 20 Hz–550 MHz | < 50 mV to 150 MHz | 7 | 1 Hz, 10 Hz, 100 Hz | $139.95 |
| CT-90 | 10 Hz–600 MHz | < 10 mV to 150 MHz<br>< 150 mV to 600 MHz | 9 | 0.1 Hz, 10 Hz, 100 Hz | $169.95 |
| CT-125 | 10 Hz–1.25 GHz | < 25mV to 50 MHz<br>< 15 mV to 500 MHz<br>< 100 mV to 1 GHz | 9 | 0.1 Hz, 1 Hz, 10 Hz | $189.95 |
| CT-250 | 10 Hz–2.5 GHz typically 3.0 GHz | < 25 mV to 50 MHz<br>< 10 mV to 1 GHz<br>< 50 mV to 2.5 GHz | 9 | 0.1 Hz, 1 Hz, 10 Hz | $249.95 |
| PS10B Prescaler | 10 MHz–1.5 GHz, divide by 1000 | < 50 mV | Convert your existing counter to 1.5 GHz | | $89.95 |

## SPEED RADAR
**$89.95 complete kit SG-7**

New low-cost microwave Doppler radar kit "clocks" cars, planes, boats, horses, bikes or any large moving object. Operates at 2.6 GHz with up to 1/4 mile range. LED digital readout displays speed in miles per hour, kilometers per hour or feet per second! Earphone output allows for listening to actual doppler shift. Uses two 1-lb coffee cans for antenna (not included) and runs on 12 VDC. Easy to build—all microwave circuitry is PC stripline. ABS plastic case with speedy graphics for a professional look. A very useful and full-of-fun kit.

## BROADBAND PREAMP

Boost those weak signals to your scanner, TV, shortwave radio or frequency counter. Flat 25 dB gain, 1 to 1000 MHz. 3 dB NF. BNC connectors. Runs on 12 VDC or 110 VAC.
PR-2, wired, includes AC adapter ..... $59.95

## 2M POWER AMP

Easy to build power amp has 8 times power gain, 1W in, 8W out, 2W in, 16W out, 5W is for 40W out. Same amp as featured in many ham magazine articles. Complete with all parts, less case and T-R relay.
PA-1, 40W pwr amp kit ..... $34.95
TR-1, RF sensed T-R relay kit $11.95

## FM WIRELESS MIKE KITS

FM-3 SHOWN

Pick the unit that's right for you. All units transmit stable signal in 88-108 MHz FM band up to 300' except for hi power FM-4 that goes up to 1/2 mile.
FM-1, basic unit ..... $5.95
FM-2, as above but with added mike preamp ..... $7.95
FM-4, long range, high power with very sensitive audio section, picks up voices 10' away ..... $14.95
MC-1, miniature sensitive mike cartridge for FM-1,2,4 ..... $2.95

### MICROWAVE INTRUSION ALARM

A real microwave Doppler sensor that will detect a human as far as 10 feet away. Operates on 1.3 GHz, and is not affected by heat, light, or vibrations. Drives up to 100 mA output, normally open or closed, runs on 12 VDC.
Complete kit MD-3 . $19.95

### MUSIC MACHINE

Neat kit that will produce 25 different classical and popular tunes, plus 3 doorchime sounds. Lots of fun for doorbells, shop, or store entrances, car horn, music boxes, etc. Runs on 9V battery or wall transformer. Excellent speaker volume and adjustable tempo and pitch. Add our case set for a handsome finished look.
Complete kit, MM-5 ..... $24.95
Case + knob set, CMM-5 $12.95

### PACKET RADIO

Two new versions are available for the Commodore 64 (P-64A) or the IBM-PC (P-IBM). Easy assembly "NO TUNING". Includes FREE disk software, PC Board and Full Documentation.

| | | |
|---|---|---|
| KIT | P-64A | $59.95 |
| | P-IBM | $59.95 |
| CASE | CPK | $12.95 |

### LO NOISE PREAMPS

Make that reciever come ALIVE! Small size for easy installation with Hi-Q tuned input for peak performance. Excellent gain and noise figure—guaranteed to improve reception! Specify band: 2M—PR-10, 220 MHz—PR-20, 440 MHz—PR-40.
Each kit ..... $17.95

### TONE DECODER

A complete tone decoder on a single PC board. Features: 400–5000 Hz adjustable range via 20-turn pot, voltage regulation, 567 IC. Useful for touch-tone burst detection, FSK, etc. Can also be used as a stable tone encoder. Runs on 5 to 12 volts.
Complete kit, TD-1 **$6.95**

### VOICE ACTIVATED SWITCH

Voice activated switch kit provides switched output with current capability up to 100 mA. Can drive relays, lights, LED, or even a tape recorder motor. Runs on 9 VDC.
VS-1 kit ..... $6.95

### TELEPHONE TRANSMITTER

Mini-sized with professional performance. Self-powered from phone line, transmits in FM broadcast band up to ¼ mile. Installs easily anywhere on phone line or inside phone!
PB-1 kit ..... $14.95

## NEW
## SPEAKER PHONE

Talk on the phone hands-free, great to put in shop or shack, press the button to answer—no actual phone needed. Works same as commercial units. Talk from anywhere in room, phone line powered—no battery needed. Super for family and conference calls or buy two for hands-free intercom! Add our case set for a pro look.
SP-1 ..... $29.95 Case-CSP ..... $12.95

### TICKLE STIK

A shocking kit! Blinking LED attracts victims to pick up innocent-looking can—you watch the fun! Ideal for office desks, parties, nosey know-it-alls!
TS-4 kit ..... $9.95

### LIGHT BEAM COMMUNICATORS

Transmits audio over infrared beam up to 30'—use simple lenses to go up to ¼ mile! Hum free, uses 30 kHz carrier. Great for wireless earphones or undetectable "bug." Transmitter + receiver set, LB56 . $19.95

### FM RADIO

Full-fledged superhet, microvolt sensitivity, IC detector and 10.7 MHz IF. Tunes Std. FM broadcast band as well as large portions on each end. Ideal for "bug" receiver, hobby experiments or even as FM radio!
FR-1 kit ..... $19.95

### SUPER SLEUTH

A super sensitive amplifier which will pick up a pin drop at 15 feet! Great for monitoring baby's room or as general purpose amplifier. Full 2W rms output. Runs on 6 to 15 volts, uses 8–45 ohm speaker.
BN-9 kit ..... $6.95

### BROADBAND PREAMP

Very popular sensitive all-purpose preamp, ideal for scanner, TVs, VHF/UHF rigs, counters. Lo noise, 20 dB gain, 100 kHz–1 GHz, 9V–12 VDC operation.
SA-7 kit ..... $14.95

## •2 METERS
## •223 MHz
## •440 MHz

**$149⁹⁵**

# FANTASTIC FM TRANSCEIVERS

### SYNTHESIZED—NO CRYSTALS

Ramsey breaks the price barrier on FM rigs! The FX is ideal for shack, portable or mobile. The wide frequency coverage and programmable repeater splits makes the FX the perfect rig for Amateur, CAP or MARS applications. Packeteers really appreciate the dedicated packet port, "TRUE-FM" signal and almost instant T/R switching. High speed packet? .... No problem. Twelve diode programmed channels, 5W RF output, sensitive dual conversion receiver and proven EASY assembly. Why pay more for a used foreign rig when you can have one AMERICAN MADE (by you) for less. Comes complete less case and speaker mike. Order our matching case and knob set for that pro look.

| | |
|---|---|
| FX-146 kit (2 Meters) | $149.95 |
| FX-223 kit (1¼ Meters) | $149.95 |
| FX-440 kit (3/4 Meters) | $169.95 |
| CFX matching case set | $ 24.95 |

### 2 MTR & 220 BOOSTER AMP

Here's a great booster for any 2 meter or 220 MHz hand-held unit. These power boosters deliver over 30 watts of output, allowing you to hit the repeater's full quieting while the low noise preamp remarkably improves reception. Ramsey Electronics has sold thousands of 2 meter amp kits, but now we offer completely wired and tested 2 meter, as well as 220 MHz, units. Both have all the features of the high-priced boosters at a fraction of the cost.
PA-10 2 MTR POWER BOOSTER (10 X power gain)
Fully wired & tested ..... $89.95
PA-20 220 MHz POWER BOOSTER (8 X power gain)
Fully wired & tested ..... $89.95

## QRP TRANSMITTERS HAM RECEIVERS

### 20, 30, 40, 80M CW TRANSMITTERS

Join the fun on QRP! Thousands of these mini-rigs have been sold and tons of DX contacts have been made. Imagine working Eastern Europe with a $30 transmitter—that's ham radio at its best! These CW rigs are ideal mates to the receivers at right. They have two-position variable crystal control (one popular QRP XTAL included), one watt output and built-in antenna switch. Runs on 12VDC. Add our matching case and knob set for a handsome finished look.
Your choice of bands ..... $29.95
(Specify band: QRP-20, 30, 40 or 80)
Matching case & knob set, CQRP ..... $12.95

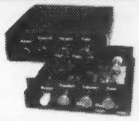
### 20, 30, 40, 80M All Mode RECEIVERS

Build your own mini ham station. Sensitive all-mode AM, CW, SSB receivers use direct conversion design with NE602 IC as featured in *QST* and ARRL handbooks. Very sensitive varactor tuned over entire band. Plenty of speaker volume. Runs on 9V battery. Very EASY to build, lots of fun and educational—ideal for beginner or old pro. New 30-page manual. Add the case set for well-fitted professional look.
Your choice of bands ..... $29.95
(Specify band: HR-20, HR-30, HR-40, HR-80)
Matching case & knob set, CHR ..... $12.95

## E-Z KEY CMOS KEYER

Send perfect CW within an hour of receiving this kit! Easy-to-build kit has sidetone oscillator, speed control and keys most any transmitter. Runs for months on a 9V battery. 28-page manual gives ideas on making your own key for extra savings. Add our matching case set for complete station look.
CW-7 kit ..... $24.95
Matching case knob set, CCW ..... $12.95

## 2, 6, 10 MTR, 220 FM RECEIVERS



Keep an ear on the local repeater gang, monitor the cops, check out the weather or just plain listen around. These sensitive superhet receivers are just the ticket. They tune any 5 MHz portion of the band and have smooth varactor tuning, dual conversion with ceramic IF filters, AFC, adjustable squelch and plenty of speaker volume. Runs on 9V battery and performance that rivals the big rigs! For a complete finished pro look, add our matching case and knob set with screened graphics.
FM communications receiver kit ..... $29.95
Specify band: FR 146 (2m), FR6 (6m), FR10 (10m), FR-220 (220 MHz)
Matching case & knob set, CFR ..... $12.95

## ACTIVE ANTENNA

Cramped for space? Get longwire performance with this desktop antenna. Properly designed unit has dual HF and VHF circuitry and built-in whip antenna, as well as external jack. RF gain control and 9V operation makes unit ideal for SWLs, traveling hams or scanner buffs who need hotter reception. The matching case and knob set gives the unit a hundred dollar look!
AA-7 Kit ..... $24.95
Matching case & knob set, CAA ..... $12.95

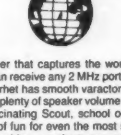
## SPEECH SCRAMBLER

Communicate in total privacy over phone or radio. Kit features full duplex operation using frequency inversion. Both mike and speaker or line in/out connections. Easy hookup to any radio, and telephone use requires no direct connection! Easy to build 2 IC circuit. Can also be used to descramble many 2-way radio signals. Finish your kit off with the handsome case & knob set.
SS-7 kit ..... $29.95
Matching case & knob set, CSS ..... $12.95

## FM STEREO TRANSMITTER

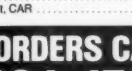
Run your own stereo FM station! Transmit a stable signal in the standard FM broadcast band throughout the house, dorm or neighborhood. Connects easily to line outputs on CD player, tape decks, etc. Runs on 9V battery, has internal whip antenna and external antenna jack. Add our case set for a "station" look!
FM-10 kit ..... $29.95
Matching case set, CFM ..... $12.95

## SHORTWAVE RECEIVER



Fantastic receiver that captures the world with just a 12" antenna! Can receive any 2 MHz portion from 4–11 MHz. True superhet has smooth varactor tuning, AGC, RF gain control, plenty of speaker volume and runs on a 9V battery. Fascinating Scout, school or club project provides hours of fun for even the most serious DXer. For the car, consider our shortwave converter. Two switchable bands (in 3–22 MHz range), each 1 MHz wide—tunable on your car radio dial. Add some interest to your drive home!
Shortwave receiver kit, SRI ..... $29.95
Shortwave converter kit, SCI ..... $27.95
Matching case set for SRI, CSR ..... $12.95
Matching case set for SCI,CSC ..... $12.95

## AIRCRAFT RCVR



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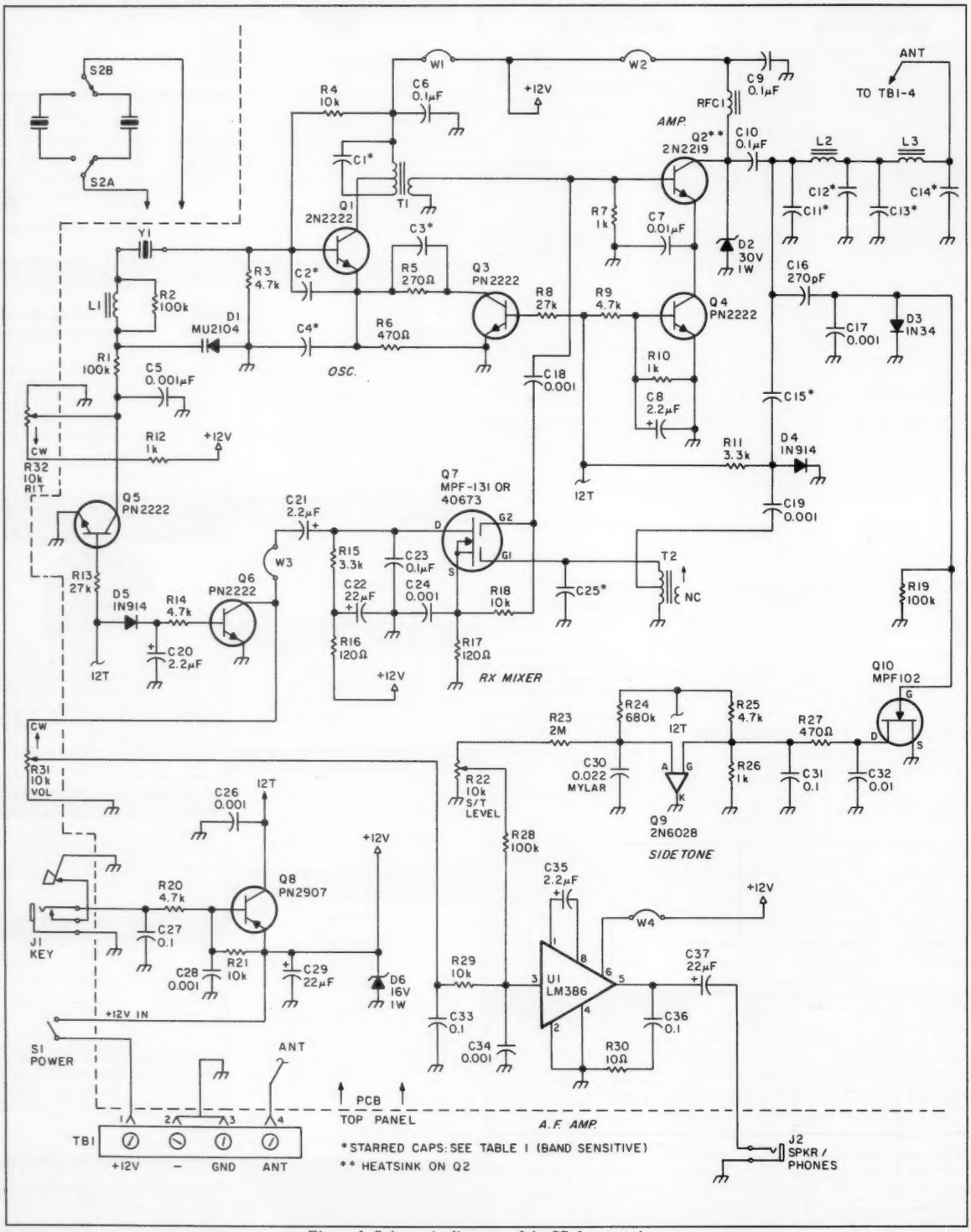


*Figure 1. Schematic diagram of the SP-1 transceiver.*

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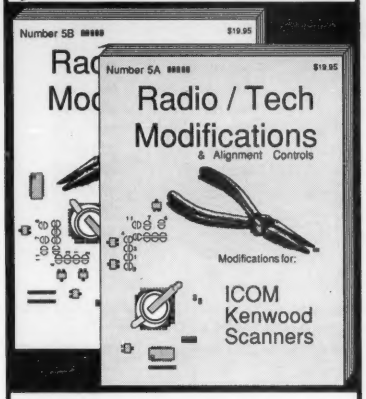


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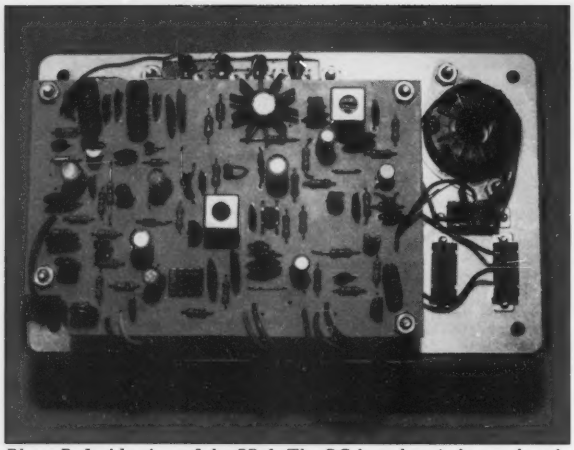

*Photo B. Inside view of the SP-1. The PC board, switches and sockets are mounted directly to the bottom side of the project box metal cover.*

**Table 1. Band Data**

| | 80-M | 40-M | 30-M |
|---|---|---|---|
| C1 | 390 pF | 68 pF | Not used |
| C2 | 18 pF | Not used | Not used |
| C3 | 680 pF | Not used | Not used |
| C4 | 820 pF | 680 pF | 390 pF |
| C11 | 390 pF | 100 pF | Not used |
| C12 | 820 pF | 820 pF | 270 pF |
| C13 | 680 pF | Not used | 270 pF |
| C14 | 680 pF | 390 pF | 270 pF |
| C15 | 39 pF | 27 pF | 18 pF |
| C25 | 390 pF | 68 pF | Not used |
| L1 (FT37-61) | 40T #30 | 23T #28 | 17T #28 |
| L2-L3 (T50-2) | 19T #24 | 14T #24 | 12T #24 |

Capacitors are ceramic disk type. C15 may be a trimmer capacitor spanning the range shown above (Mouser 24AA024. 9-50 pF).

For inductors, wind turns using the enamel wire gauge given on the toroid core type specified.

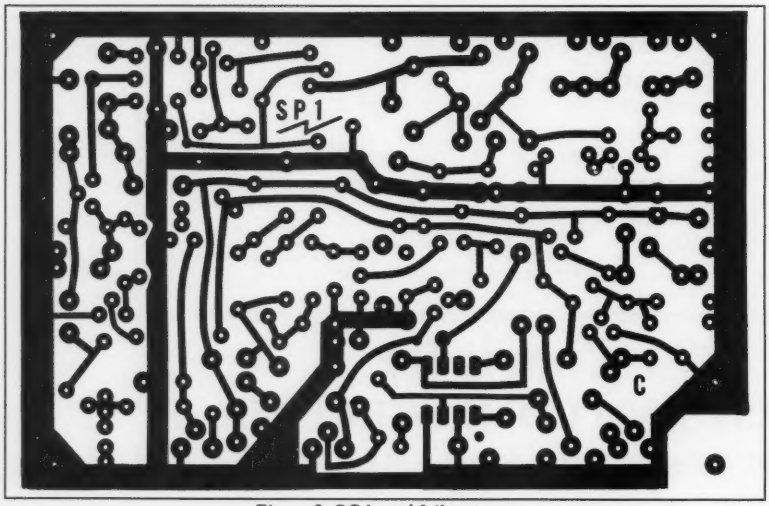


*Figure 2. PC board foil pattern.*

**Parts List**

| | |
|---|---|
| C1-C4, C11-C15, C25 | (See Table 1) |
| C30 | 0.022 µF Mylar(TM) (RS 272-1066) |
| D1 | MV2104, ECG612, 1S2687 |
| D2 | 30V, 1W zener diode (1N4751) |
| D3 | 1N34, RS 276-1123 |
| D4-D5 | 1N914 or 1N4148 |
| D6 | 16V, 1W zener diode (1N4745) |
| J1-J2 | 3.5 mm closed-circuit mini phone jack |
| L1-L3 | (see Table 1) |
| Q1 | 2N2222, ECG123A |
| Q2 | 2N2219, ECG128, RS 276-2030 |
| Q3-Q6 | PN2222, ECG123AP, RS276-2009 |
| Q7 | MPF-131, ECG222, 40673 |
| Q8 | PN2907, ECG159 |
| Q9 | 2N6028, ECG6402 (P.U.T.) |
| Q10 | MPF102, ECG312, RS 276-2062 |
| R31-R32 | 10K audio taper potentiometer, RS 271-1721 |
| RFC1 | 22-33 µH epoxy-coated (Mouser 43LS275) or 22 turns #28 enameled on FT37-61 core |
| T1-T2 | Mouser 42IF123 |
| U1 | LM386, ECG823, RS 276-1731 |
| Y1 | Fundamental, FT-243 holder, 32 pF load. Order 1 kHz above desired transmitting frequency. |

Note: PC boards and project kits for the SP-1 "Spider" are available from *Lectrokit*, 401W. Bogart Rd., Sandusky OH 44870 (no telephone). SP-1BBM, $12, includes bare PC board and step-by-step construction manual. SP-1PCK, $29, includes SP-1BBM plus all PC board parts, including those necessary for 80, 40 and 30 meter operation. SP-1KIT, $39, is the complete kit containing all the above plus case and case parts, but not operating crystals. Include $4 shipping and handling for SP-1PCK and SP-1KIT orders; the SP-1BBM is postpaid, USA. Ohio residents please add appropriate sales tax. Order direct or send an SASE for current details. This pricing is valid within six months of publication.

here but intended for future audio filter switching or other contingencies. Left of S3, in the left-front corner, is DC power control switch S1.

Nearly all parts reside on the PC board depicted by the etching pattern shown in Figure 2 and the parts overlay, Figure 3. Band-sensitive part values are listed in Table 1. PC boards and project kits for the Spider are available (see the Parts List). The finished PC board is first wired to all the top panel parts except the antenna and ground lugs of TB1 (lugs 4 and 3 respectively) and the common terminals of crystal select switch S2. The board is then hinged over, to be suspended below the top panel (parts down) on 5/8-inch metal spacers. Now the short RF connections to TB1 and S2 can be made.

Overall, this packaging method is economical and makes servicing a snap. Metal work is confined to just one flat panel. Except for TB1 and the key contact, all the innards can be removed intact should you desire to paint and letter the top panel. The case is a Radio Shack No. 270-627 measuring 6.25" x 3.75" x 2" and the finished weight of the SP-1, with two crystals plugged in, is 11 ounces.

I'd be remiss if I failed to mention a lucky coincidence. The entire Spider will nestle into a plastic card file box, with ample room below for the battery pack. Post sked details and secure "ear buds" fit inside the top cover for the ultimate find-in-the-dark convenience. Close the lid and crystals and operating controls are no longer exposed and vulnerable to the rigors of your march. The card file box is a Sterling Plastics No. 529. I use them for QSL storage and see them in the office supply section of stores everywhere. Now at least the radio will survive.

### Tune-Up

Connect 12-14 VDC and wattmeter with dummy load to TB1 as described earlier. I recommend a lower than normal (0.5 amp) in-line fuse at first, to minimize damage in case of a major wiring error or soldering mistake. Switch on and close the key. You should hear high-pitched sidetone in the speaker or phones. Install a crystal for the band of choice and increase the fuse rating to 1 or 2 amps (if it hasn't blown!). Close the key and adjust T1 for

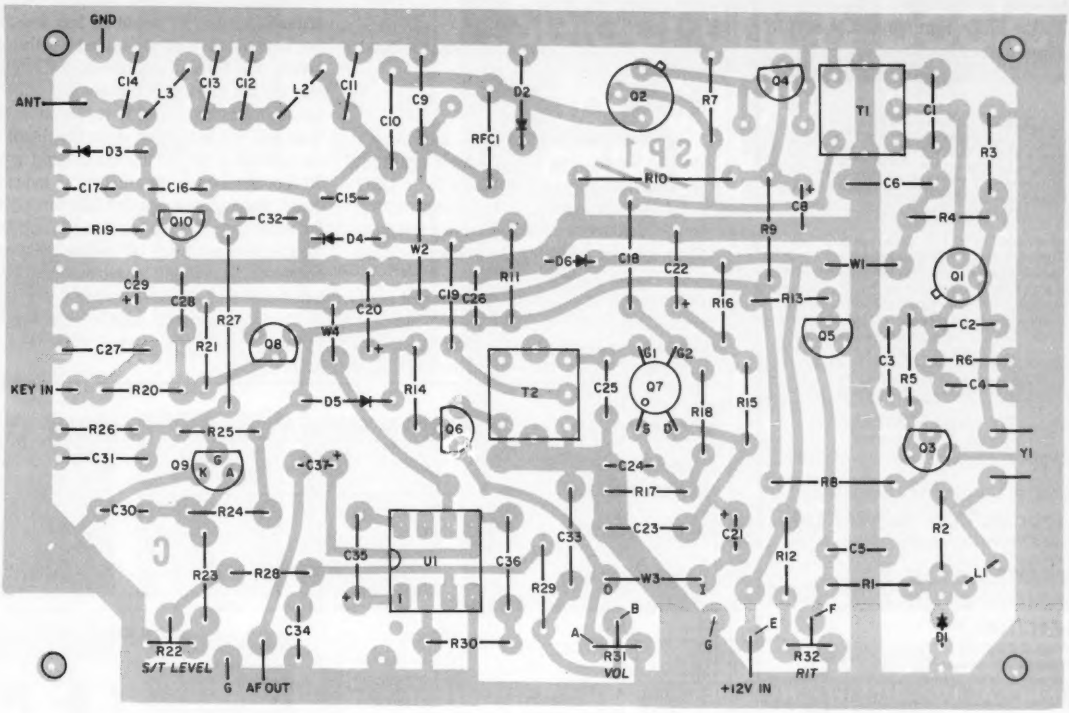


*Figure 3. PC board parts placement. To disable the transmitter, remove wire jumper W2. Also remove R27 to lower sidetone pitch to normal with transmitter disabled.*

## Spider in the Field

Sure, the Spider's cute, but is it really practical? We decided to test it in a worst-case scenario on 80 meters. My brother Jim NZ8B grabbed some camping gear, the 80M SP-1 prototype, 65 feet of wire and a 12-volt lantern battery and headed for the hills near Athens, Ohio, about 175 miles distant. Just prior to his departure, we did a quick dial calibration check noting the precise transmission frequency of his main and back-up crystals.

We chose 7:30 p.m. for our nightly schedule time, hoping to catch the window between D-layer breakup and QRN/QRM build-up. With two exceptions, this schedule was maintained for the next 16 days as Jim moved around sampling the camping and hiking fare at various locations. One sked was missed due to freezing temperatures (no antenna at the motel refuge) and another because of a thunderstorm on my end. Otherwise, Spider signals ranged from RST 339 to 569. This was good enough for our brief exchanges but not always armchair copy. With 100 watts going his way, I had no trouble breaking him (QSK) for fills or to mark time during a deep fade. Jim also carried a 3581 kHz crystal for W1AW bulletin reception and reported an "uncanny feeling" hearing the grand old station by campfire light in the midst of a dark forest!

Upon his return, we duplicated the typical field installation to take some measurements. The antenna was a quarter-wave "lazy inverted L" which rose 25 feet up from the rig, bent around a tree limb, and then sloped gradually downward to a height of about seven feet. The ground system was an eight-inch tent stake (we said this was a worst-case scenario!). SWR measured 4:1, No doubt confirming the high ground resistance and implying rather low radiation efficiency. Nevertheless, it worked.

We experimented with simple earth grounds and concluded that, for a Marconi antenna like this, three eighth-wave radials (33 feet long) far surpass the tent stake. SWR fell to 1.4:1 and relative field strength increased noticeably. On 40 or 30 meters (and 80 if you can), a simple half-wave dipole strung "inverted V" fashion would be hard to beat.

The 12-volt lantern battery, it turned out, was actually delivering only 11.2 VDC (key down) to the Spider, resulting in just 800 mW of RF output. A better choice would be nine or 10 carbon-zinc cells or 12 NiCds, "AA" size or bigger in either case. This way, the greatest portion of the battery discharge curve will be above 12 volts rather than below.

The "earbuds" used for listening had too much high-frequency response, resulting in unwanted background hiss even with the volume turned down. A pair of inexpensive mono earplugs Y'd together might do a better job in this application. All in all, the field trial was a success. We kept in touch, and afterward learned how to pick up an easy S-unit by optimizing the battery and earth ground.

maximum power output. The sidetone pitch should be distinctly lower if the smart-tone is working. Connect an antenna and adjust T2 for best receive when you hear a signal. That's it.

I experienced no difficulty with AM detection on 80 and 40, even though this receiver type is known to be prone. On 30 meters in the evening, a couple of North American broadcasters in the 31 meter band became intermittently audible, but code signals in the ham band remained readable. Most other times 30 meters is clear. If you have a problem with AM detection, reduce the value of C15 to

*Continued on page 30*

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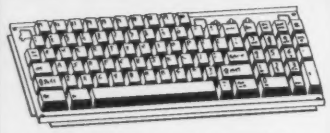

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CIRCLE 194 ON READER SERVICE CARD

## The SP-1 Transceiver

*Continued from page 29*

minimize it at the expense of some "in-band" sensitivity.

### On the Air

With the Spider's rather broad selectivity, it may not be obvious if the signals heard are close enough to your frequency for a QSO. Those that approach zero-beat with the RIT control fully counterclockwise are very close. Others may be workable if the operator tunes around for your signal.

In addition to maintaining short-haul skeds from the field (see the sidebar), I had anticipated months of fun trying to extend Spider DX on all three bands from my home QTH. But right off the bat, 40 meters produced KBØIZC in Kansas, followed by a couple of West Coast stations. Maybe 80 would be less fruitful . . . no. With the rig still clip-leaded together on the bench, VE7WIN in Coquitlam, B.C., fell right into my lap (er, web!). Further down the log, I see (and well recall) a 559 report on 30 meters from VK2VA in Sydney, Australia. In all cases, the antenna used was my old reliable, a 45- by 70-foot inverted L. So, this rig is indeed adequate, despite its simplicity and low cost. But the results are, more often than not, a tribute to the forgiving nature of HF radiotelegraphy and, occasionally, bull-dog tenacity at the other end. Good luck with the SP-1 Spider!

My thanks to Jim NZ8B, who suggested "smart-tone" and assisted with SP-1 field trials.

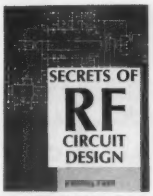
## Programmable-Frequency Audio Generator

*Continued from page 16*

| From Pin | To IC | Pin |
|---|---|---|
| **U1 ML2036** | | |
| 1 | -5V | |
| | C2 | |
| 2 | -5V | |
| 3 | NC | |
| 4 | 1 | 5 |
| | 3 | 14 |
| 6 | 6 | 3 |
| 7 | 4 | 8 |
| | 5 | 1 |
| 8 | +5V | |
| | C1 | |
| | R3 | |
| 9 | R3 | |
| 10 | LM741 | 2 |
| 11 | GND | |
| 12 | GND | |
| 13 | S2 | Common |
| 14 | Y1 | |
| **U2 74150** | | |
| 1 | J1 | 8 |
| 2 | J1 | 7 |
| 3 | J1 | 6 |
| 4 | J1 | 5 |
| 5 | J1 | 4 |
| 6 | J1 | 3 |
| 7 | J1 | 2 |
| 8 | J1 | 1 |
| 9 | GND | |
| 10 | 6 | 1 |
| | 6 | 2 |
| 11 | 3 | 11 |
| | 4 | 4 |
| 12 | GND | |
| 13 | 3 | 8 |
| | 4 | 5 |
| 14 | 3 | 9 |
| | 4 | 2 |
| 15 | 3 | 12 |
| | 4 | 1 |
| 16 | J1 | 16 |
| 17 | J1 | 15 |
| 18 | J1 | 14 |
| 19 | J1 | 13 |
| 20 | J1 | 12 |
| 21 | J1 | 11 |
| 22 | J1 | 10 |
| 23 | J1 | 9 |
| 24 | +5V | |
| **U3 74LS93** | | |
| 1 | 3 | 12 |
| 2 | 3 | 3 |
| | 7 | 12 |
| 5 | +5V | |
| 10 | GND | |
| 3 | 4 | 10 |
| 6 | 4 | 9 |
| 7 | GND | |
| 8 | 5 | 1 |
| 14 | +5V | |
| **U5 74LS32** | | |
| 2 | 6 | 8 |
| | 6 | 12 |
| 3 | 7 | 1 |
| 7 | GND | |
| 14 | +5V | |
| **U6 74LS00** | | |
| 7 | GND | |
| 9 | 6 | 11 |
| 10 | R1 | |
| | N.O. Terminal, S1 | |
| 13 | R2 | |
| | N.C. Terminal, S1 | |
| 14 | +5V | |
| **U7 74LS73** | | |
| 2 | +5V | |
| 3 | +5V | |
| 4 | +5V | |
| 11 | GND | |
| 14 | +5V | |
| **U8 ML2035** | | |
| 1 | -5V | |
| 2 | 3 | 14 |
| | 9 | 2 |
| 3 | 6 | 3 |
| 4 | 4 | 8 |
| 5 | +5V | |
| 6 | LM741 | 2 |
| 7 | GND | |
| 8 | Crystal | |
| **U9 CD4049** | | |
| 1 | +5V | |
| 2 | C3 | |
| 3 | 9 | |
| | RT | |
| 5 | RIN | |
| 8 | GND | |
| **U10 LM 741** | | |
| 2 | LM741 | 6 |
| 3 | GND | |
| 4 | -5V | |
| 6 | Input of audio circuit under test | |
| 7 | +5V | |

*Table 1. Programmable-frequency audio generator master wire list (for wire-wrapping purposes).*

3222P $16.95

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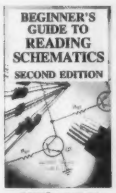


3632P $10.95

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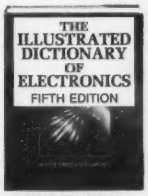


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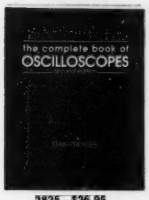


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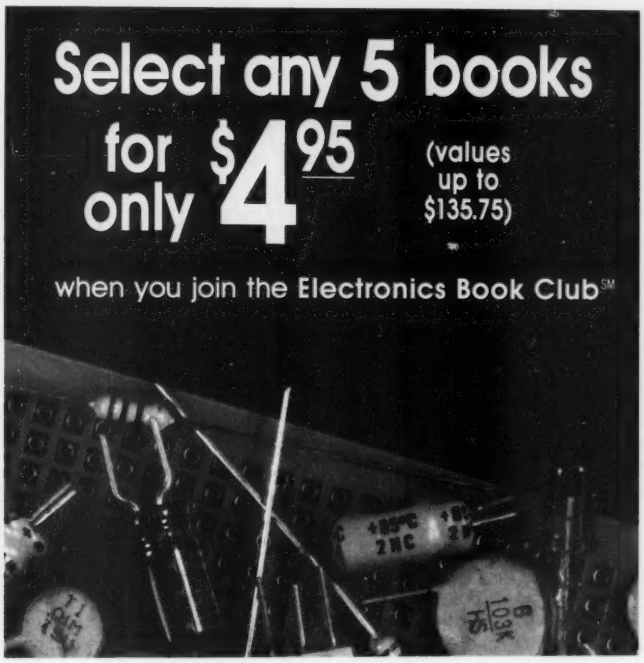


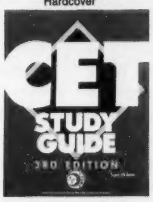


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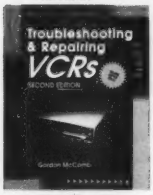


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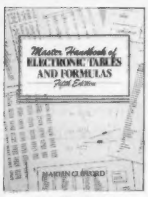


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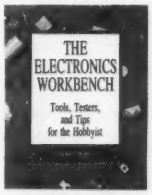


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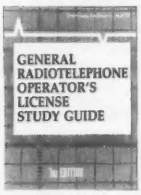


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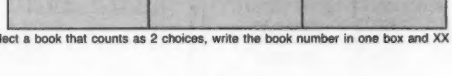

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STAR193

# Twin Crystal Ladder Filters

*Upper or lower sideband filters using inexpensive crystals.*

by John Pivnichny N2DCH

Crystal ladder filters are a good way to provide the selectivity required in single sideband transceiver equipment. Pochet[1], Hardcastle[2], and Hayward[3] have described the basic approaches for these filters. Their unique characteristic is that all crystals used in a filter are of the same (identical) frequency. This allows you to make use of the low-cost "microprocessor" and "colorburst" crystals now available in a variety of specific frequencies. With these filters, it's no longer necessary to specially order and pay lots of money for specifically cut crystal frequencies.

In this article I describe two filters designed for lower sideband and upper sideband service using a common carrier frequency. Both filters are constructed from 9830.4 kHz microprocessor crystals available from DigiKey (Digi-Key Corporation, Catalog #925, page 110, part number X087, 9.8304 MHz crystal, 20 pF load capacitance).

A transmitter carrier frequency, or BFO in a receiver application, can be supplied by a single oscillator operating at approximately 9829.5 kHz and using another 9830.4 kHz crystal. A suggested circuit for this oscillator is given.

The filters are shaped to provide either upper or lower sideband operation with excellent suppression of the unwanted sideband. I suggest that you incorporate both filters in transceiver designs. In some applications, such as simultaneous transmission/reception of slow-scan video on one sideband and voice on the other, both filters could be in operation at one time. This simultaneous use of both sidebands is also referred to as "independent sideband," ISB[4].

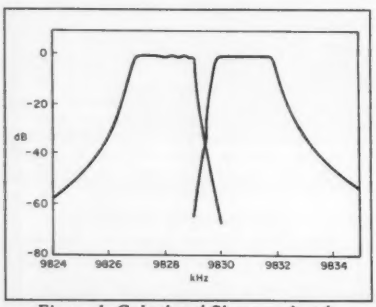


*Figure 1. Calculated filter passbands.*

## Filter Circuits

Figure 1 shows calculated filter passbands; Figure 2 shows corresponding schematics for the two filter circuit diagrams. Note that the same terminating resistance is used for either filter. This is only possible through the unconventional use of an inductor at both ends of the lower sideband filter. The capacitor values for both filters were carefully selected to provide passbands which are mirror images reflected about the carrier frequency. The passbands are 35 dB down at the carrier and provide suppression of the unwanted sideband well in excess of 80 dB. Ultimate rejection of the other skirt is over 60 dB. These are very good figures for relatively simple home-built filters. They are easily duplicated with ordinary construction practices, as described below.

## Crystal Measurements

The crystals are specified by Digi-Key as +/-50 parts per million at 25 degrees Celsius, with another +/-100 ppm from zero to 70 degrees C. Aging is another 10 ppm per year. This works out to be +/-492 hertz initial tolerance. I found the series resonant frequencies to be much better matched.

Using the 50-ohm test circuit shown in Figure 3, I measured a batch of 20 crystals and got the results shown in Table 1. The average series resonant frequency of the first eight measurements was 9,825,945 Hz with just over 100 Hz, plus or minus deviation. The average series resistance was 33 ohms +/-4 ohms. Motional capacitance is 0.02438 pF and motional inductance 10.76 mH. These were measured using Hayward's technique and formulas. The holder capacitance appears to be about 7 pF.

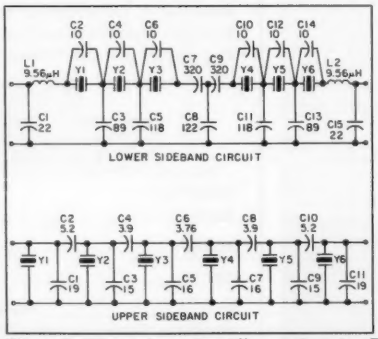


*Figure 2. Filter schematics. All capacitors in pF.*

Measurements on crystals 9 to 20 also averaged 9,825,945 Hz (wow) with slightly over 250 Hz plus or minus worst case deviation. With such excellent matching, it is safe to recommend selecting crystals at random and just soldering them in to build the filters. It's not necessary to take crystal measurements first.

Of course, if you were thinking of building a CW bandwidth filter, then I would match the crystals to under 100 Hz, but with these SSB bandwidths, that just doesn't seem necessary. Duplicating these filters is much easier if you don't have to measure each crystal.

Note that the calculated passbands shown in Figure 1 were based on the measured capacitance and inductance values for the crystals given above. If you want to reproduce these calculations and have them come out exactly on frequency, then use a more accurate value of the motional inductance of 10.76113 mH.

## Inductors

As originally designed, the lower sideband filter had a series capacitor of 118 pF at each end. The termination resistance was 201 ohms. I wanted to "step" this up to 2,831 ohms to match the impedance of the upper sideband filter. A step up is only possible if you add a series inductor and shunt end capacitor. In essence, the inductor cancels out some of the high reactance of the shunt end capacitor and makes it look like a higher value (lower reactance) series capacitor. You could also step up the impedance with a transformer using a ferrite toroid core.

The inductor value is not particularly critical because it is not resonant with anything in the neighborhood of 9.830 MHz. It is merely used for impedance transformation and normal tolerances are OK. Fifty-five turns of #30 gage copper wire on a T37-6 (yellow) toroid core gives the right value of

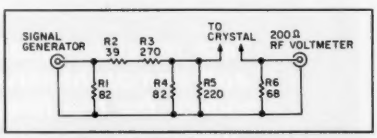


*Figure 3. 50-ohm test circuit.*

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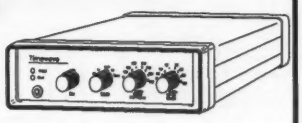

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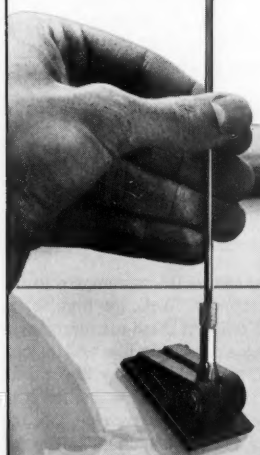

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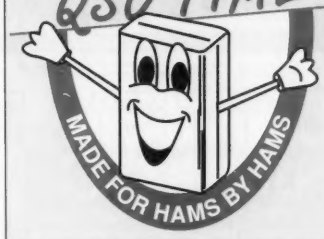


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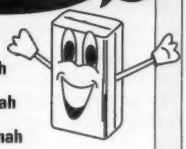

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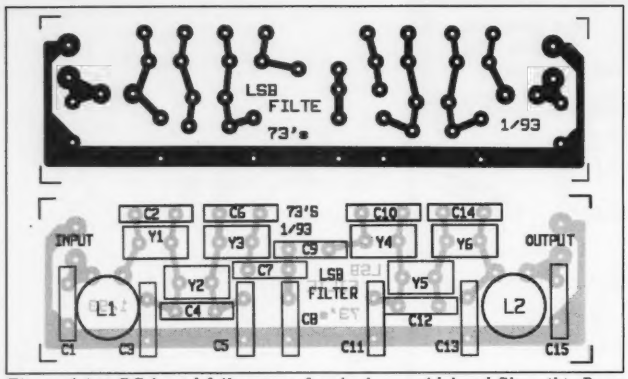


*Figure 4 (a). PC board foil pattern for the lower sideband filter. (b). Parts placement diagram.*

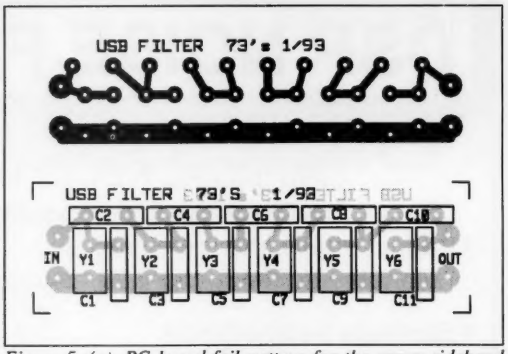


*Figure 5. (a). PC board foil pattern for the upper sideband filter. (b). Parts placement diagram.*

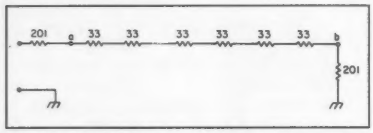


*Figure 6. Circuit for estimating insertion loss of the lower sideband filter.*

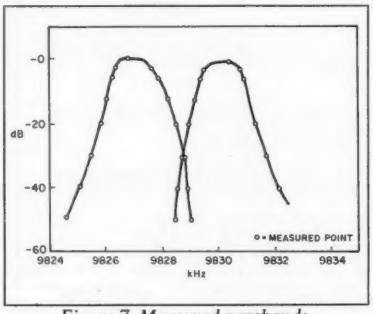


*Figure 7. Measured passbands.*

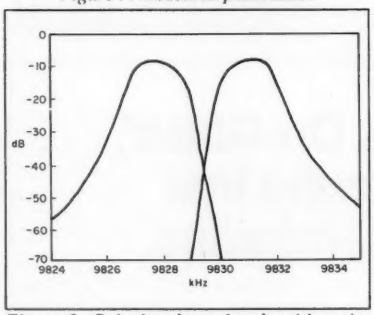


*Figure 8. Calculated passbands with series resistance included.*

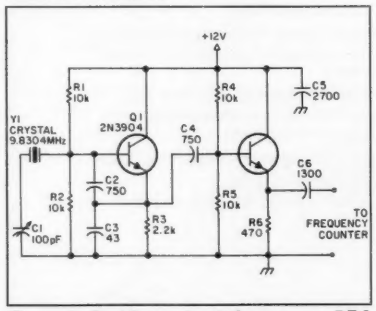


*Figure 9. Oscillator circuit for use as a BFO or transmitter carrier.*

inductance, with a Q of about 160. You can check the value quickly by temporarily soldering a 100 pF capacitor across the ends of the wound toroid. Leave enough lead length to form a one-inch-diameter loop. Then check the resonant frequency with a dip meter placed near the loop. It should read about 5.15 to 5.17 MHz. If it's way off, add or remove a turn or two.

### Capacitors

Like the inductors, the capacitor values are also not particularly critical. I used small 50-volt ceramic capacitors from NTE (tolerance unknown). If you want to be a purist about it, go with silver micas, but I don't think that's necessary in a home-built filter.

### Construction

I use one-ounce, single-sided epoxy glass circuit board cut into a 3/4-inch strip with a coping saw. With the foil side up, I mark component hole locations by eye with a sharp-pointed metal scribe. Then I drill the marked points using a #60 drill bit (0.040-inch diameter) in a hand drill. Points which connect to the ground plane are left as is, and all other holes are countersunk with a 0.12-inch diameter bit. About five turns of the hand crank of the drill is enough at each hole. This leaves a nice insulated through-hole position. The remaining epoxy glass holds the component lead centered in the countersunk hole.

A 2-1/2-inch length of circuit board was enough for my upper sideband filter. This may vary somewhat depending on the size of your capacitors, but mine required three inches for the lower sideband filter in order to fit in the inductors. I fastened down the inductors with a 4-40 nylon machine screw and nylon nut after first placing one layer of black tape on the foil under the inductor.

Components are then inserted and soldered together on the back side. Ground connections are made on the front side as needed. This drilling technique makes an excellent filter. If you're going to build many copies of the filters, then an etched circuit board might be in order, but for just one or two, the drilling approach is faster and provides a solid ground plane for shielding.

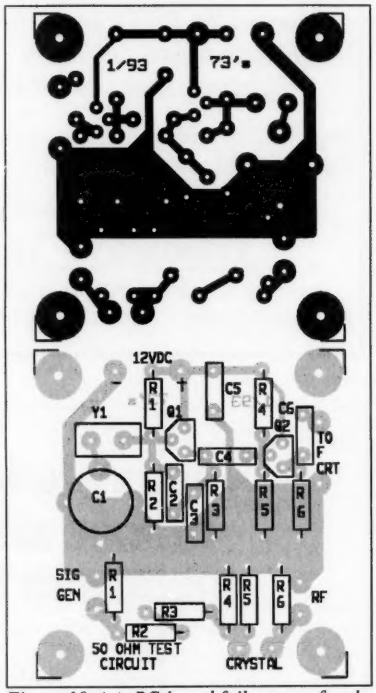


*Figure 10. (a). PC board foil pattern for the oscillator circuit. (b). Parts placement. Note that the 50-ohm test circuit shown in Figure 3 is incorporated on this board.*

*[Ed. Note: Etched and drilled PC boards are available for the two filters as well as the oscillator test circuit from FAR Circuits. The foil patterns and parts placement for these boards are shown in Figures 4 and 5.]*

### Final Check

How do the actual filters compare to the calculated responses? Well, the high series resistance (33-ohm) of these microprocessor crystals creates an insertion loss and distorts the pattern somewhat. One way to estimate this loss for the lower sideband filter is to temporarily ignore the reactive elements, the capacitors and inductors, and just look at the resistances (see Figure 6). Use the original termination, before stepup, of 201 ohms. Note—the impedance stepup does not

change the insertion loss.

The crystal series resistors create a resistive voltage divider circuit between the filter input and the final terminator, points a and b in Figure 6. The loss is:

$$\text{Loss} = \frac{198}{201 + 198} = 0.496 = -6.09 \text{ dB}$$

I haven't found any easy way to estimate the insertion loss of the upper sideband filter. It turns out to be about the same, however, preserving the symmetry of the two filters.

My actual measurements of the filter passbands are shown in Figure 7. These are only approximate because of the limitations of my simple home-brew instrumentation. Note the more rounded passbands but still very steep skirts. Reasonable symmetry and spacing between the two filters demonstrates their usefulness for upper and lower sideband service. If the series resistance is included in the calculated frequency sweeps (it was neglected in Figure 1) then the same rounded off tops and insertion loss show up—see Figure 8. In fact, there is good agreement between the calculated and measured results.

### An Oscillator

The carrier oscillator in a transmitter or BFO in a receiver should be placed at the frequency where the two passbands cross. This point is between the series resonant frequency of the crystal and the specified 20 pF load parallel resonant frequency of 9,830,400 Hz. So an oscillator circuit can be built using another crystal of the same frequency as those used in the filter. The load capacitance will have to be slightly higher than 20 pF in order to "pull" the oscillator frequency down a little.

Using the oscillator circuit shown in Figure 9, which I had already built up for an earlier project, I found the frequency could be pulled from 9,833,393 Hz down to 9,828,485 Hz by adjusting the 100 pF trimmer capacitor from a minimum of about 10 pF to its maximum of 100 pF. This is more than enough range to properly place the carrier frequency. The measured passbands cross at 9,828,700 Hz. The oscillator PC board foil pattern and parts placement are shown in Figure 10.

**Table 1. Crystal Measurements**

| Crystal # | Series Resonance (Hz) |
|---|---|
| 1 | 9,825,890 |
| 2 | 9,825,947 |
| 3 | 9,826,019 |
| 4 | 9,826,009 |
| 5 | 9,826,079 |
| 6 | 9,825,939 |
| 7 | 9,825,846 |
| 8 | 9,825,829 |
| 9 | 9,826,070 |
| 10 | 9,825,830 |
| 11 | 9,825,899 |
| 12 | 9,825,872 |
| 13 | 9,825,719 |
| 14 | 9,825,868 |
| 15 | 9,825,951 |
| 16 | 9,826,212 |
| 17 | 9,825,900 |
| 18 | 9,825,970 |
| 19 | 9,825,930 |
| 20 | 9,826,119 |

### Conclusions

Ladder crystal filters are ideal circuits to use in constructing homemade hardware because specially-cut frequencies are not needed. Low cost microprocessor crystals can be used to construct very satisfactory filters. This article shows that both upper and lower sideband filters can be made using a single crystal frequency, greatly enhancing their potential for use in multiband transceivers. They can also be used for independent sideband, ISB, service.

It appears that satisfactory filters can be built simply by purchasing low cost parts and "hooking them up." No special equipment or tuning or experience is required. So if you like to build your own ham radio gear, why not give these filters a try? 73

### References


*1) J. Pochet F6BQP "Essais, Mesures et Realisation de Fittres a Quartz,"* Radio REF, *May 1976, pages 388-391, in French.*

*2) J. Hardcastle G3JIR, "Some Experiments with High Frequency Ladder Crystal Filters,"* Radio Communication, *December 1976, pages 896-905, also in* QST, *December 1978, pages 22-24.*

*3) W. Hayward W7ZOI, "A Unified Approach to the Design of Crystal Ladder Filters."* QST, *May 1982, pages 21-27.*

*4) J. A. Dyer G4OBU, "HF Receiver Design,"* Communication Quarterly, *Volume 2, No. 3, Summer 1992, pages 81-97.*


**Parts List.**

| | |
|---|---|
| *Lower Sideband Filter* | |
| Y1—Y6 | 9.8304 MHz crystal, Digi-Key# X087 |
| L1,L2 | 9.56 µH, 30 turns on a T37-6 toroid core |
| C1,C15 | 22 pF |
| C2,C4,C6, C10,C12,C14 | 10 pF |
| C3,C13 | 89 pF |
| C5,C11 | 118 pF |
| C7,C9 | 320 pF |
| C8 | 122 pF |
| *Upper Sideband Filter* | |
| Y1—Y6 | 9.8304 MHz crystal, Digi-Key# X087 |
| C1,C11 | 19 pF |
| C2,C10 | 5.2 pF |
| C3,C9 | 15 pF |
| C4,C8 | 3.9 pF |
| C5,C7 | 16 pF |
| C6 | 3.76 pF |
| *Oscillator Circuit* | |
| Y1 | 9.8304 MHz crystal, Digi-Key# X087 |
| R1,R2,R4,R5 | 10k resistor |
| R3 | 2.2k |
| R6 | 470 ohm |
| C1 | 100 pF trimmer |
| C2,C4 | 750 pF |
| C3 | 43 pF |
| C5 | 2700 pF |
| C6 | 1300 pF |
| *50-ohm Test Circuit* | |
| R1,R4 | 82 ohm |
| R2 | 39 ohm |
| R3 | 270 ohm |
| R5 | 220 ohm |
| R6 | 68 ohm |

Note: Etched and drilled PC boards are available from FAR Circuits, 18N640 Field Court, Dundee IL 60118. Price: *Upper Sideband Filter*—$3; *Lower Sideband Filter*—$3; *Oscillator Circuit*—$3. A set of all three boards—$7. Please include $1.50 shipping per order.


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**73 Review**

*by Pete Putman KT2B*

# The Down East Microwave DEM 432K

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*Put your HF rig on the 70cm band with this easy-to-build linear transverter kit.*

The key to the growth of amateur radio in the future is to use the spectrum space above 148 MHz—valuable frequencies which are coveted by other potential commercial users. Yet, many amateurs have been discouraged by both the high cost of commercially-available multimode transceivers and the complexity of older "do-it-yourself" designs.

Down East Microwave breaks through both barriers with the DEM 432K, an easy-to-build linear transverter which offers excellent performance at a reasonable price and uses state-of-the-art broadband design technology to eliminate most of the bench work necessary to fire up the kit when completed.

### How It Works

The DEM 432K consists of three boards: a local oscillator (L70), a receive mixer and converter (R70), and a transmit mixer and converter (T70). All stages are truly linear, meaning any input mode can be reproduced faithfully. The combination of boards will upconvert your low-level transmitted signals from 28-30 MHz to 432-434 MHz, and will downconvert received signals in the opposite direction.

The LO multiplies a crystal frequency of 101.00 MHz four times to 404 MHz, then amplifies and buffers the output for stability. An on-board splitter gives you two outputs of +8 to +10 dBm, which feed both the transmit and receive converters. The only tuning adjustment which is made is to trim the crystal frequency right to 404.000 MHz—all other circuits are broadbanded.

The receive converter has NO tunable circuits, just a pair of Microwave Monolithic Integrated Circuits (MMICs) driving a Mini-Circuits mixer assembly. Overall conversion gain is about 10 to 12 dB, and an outboard GaAsFET preamplifier improves system gain to about 20 dB with a noise figure of about 0.5-0.6 dB.

The same is true for the transmit converter, which uses three MMICs to develop output at 70 cm. The nominal output is about +16 dBm linear, or close to 50 milliwatts of RF. Adding an S-AU4 power module will result in 15 to 20 watts of output power, depending on your power supply voltage.

### Construction

I ordered the whole nine yards from Bill Olsen, getting all three boards plus the S-AU4 PA kit. After wandering around several electronics parts distributors, I located a pair of enclosures for the PA, as well as the entire transverter assembly (Photo C). This was a neat trick as I hadn't even started construction yet! Longtime Microwave Modules users will recognize the approach I took right away, selecting PAC-TEC UE-692-900 and UE-351-900 die-cast boxes.

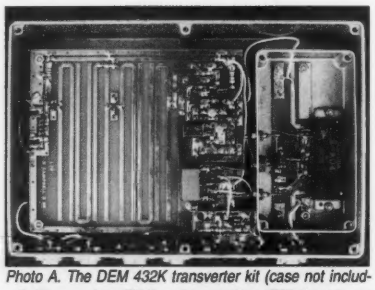

*Photo A. The DEM 432K transverter kit (case not included). The receiver (R70) and transmitter (T70) boards are stacked underneath the LO (L70) board. The PA module (432PAK) is shown on the right.*

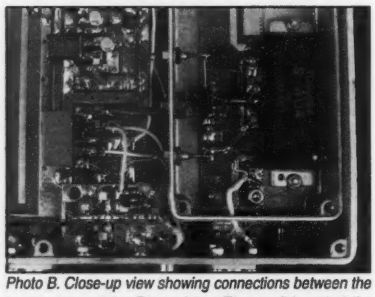

*Photo B. Close-up view showing connections between the transverter and the PA modules. The small board at the bottom is the optional preamp (designed by Steve Kostro N2CEI).*

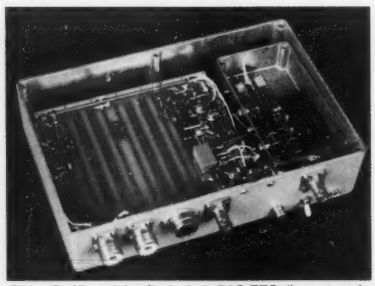

*Photo C. All modules fit nicely in PAC-TEC die-cast enclosures (not included in kit).*

Each of the boards and its associated parts comes in a zip-lock bag, and a nine-page manual with pictorial diagrams and schematics for assembly is included. The most complicated board to assemble is (as you might have guessed) the local oscillator. One note of caution: All of the boards make extensive use of microwave chip capacitors, which are very small and easily lost! My "trick" is to double up a piece of masking tape on my working surface, then stick the components to it and pull them off one at a time as needed. The chip capacitors are secured with transparent tape to a small card which identifies them by value. Your best bet is to solder all of the capacitors from each group before moving on to the next. In addition, a few chip resistors (very tiny!) are also attached to the card. Make sure you use a low-wattage soldering iron and a good pair of precision needle-nose pliers to install all chip components.

Aside from these few precautions, kit building should proceed quickly. All of the MMICs are securely packaged and labeled, and the instructions provide a visual key as to package orientation and lead length. BFX89 transistors are used as the oscillator and first buffer, and one lead will need to be clipped from each. This is shown in the assembly manual. You'll also need to wind a few coils from #24 insulated wire on a 0.1" (#33) diameter drill bit. While tedious, this shouldn't take long. Make sure you scrape the insulation from the leads before attempting to solder them!

You can build the boards in any order you like. The local oscillator board has extra pads for a second complete local oscillator to allow switching band coverage for satellite operation. (The extra components can be ordered from Down East Microwave.) Use miniature Teflon coax for all of your interconnects between boards to keep losses down. Use care when installing the TUF-1 mixer assemblies! Don't bend the leads excessively, and watch the case orientation, as spelled out in the instructions.

### Powering Up

About the only thing you'll have to do is get the local oscillator up and running. A VOM set to 250 or 500 mA scale is all that's required for the bare-bones setup, but a frequency counter would also help. After checking your component installation, apply 13.8 volts DC and rotate C1 through its range. You should see a definite peak on the VOM as the oscillator kicks in, and this should be very close to 101.00 MHz. LO current should be about 150-200 mA.

Next, check for 404 MHz output at both of the connections to the T70 and R70 mixers. If you can measure RF millivolts, anything from +7 to +10 dBm is acceptable. Trim C1 to get as close to frequency as possible—if not, add another turn to L1 and try again. Additional

*Continued on page 75*

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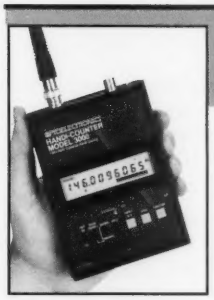

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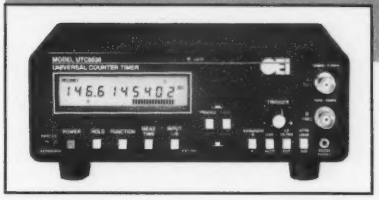

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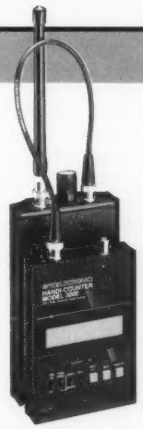

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# Handi-Beacon

## *Turn your tape recorder into a beacon controller.*

by Klaus Spies WB9YBM

The need for beacons extends beyond propagation tests. They are also very useful for range tests and equipment checks (two aspects seldom considered). Quite frequently, I have made an adjustment to my radio and not had anyone at home to help with a range test. To help solve this dilemna, I came up with a way to turn a transmitter into a useful beacon using a tape recorder and a simple interface.

My initial test setup consisted of a rubber band wrapped around a radio's microphone (to hold down the PTT) and placed near the speaker of a tape recorder. Unfortunately, this proved unreliable—if one of my cats knocked the microphone off of the tape deck or someone accidentally turned off the tape deck, I would lose both the station identification and test audio (to check readability at the noisy fringe area).

### Beacon Tape Recorder Interface

This led to the development of the circuit shown in Figure 1. One operational amplifier acts as variable gain stage, to feed audio to the transceiver's microphone audio (U1A/U1C) from the tape deck's output. This direct connection eliminates any background noise feeding into the transceiver. The second operational amplifier (U1B/U1C) drives the audio into clip. The slopes of this signal are steep enough to be seen as digital by the 4538 timer (U2A/U2B) (see Table 1), which is wired as a retriggerable leading edge oscillator. When the audio starts, the 4538 is triggered, activating the transceiver's PTT. If for some reason the audio vanishes, the radio will toggle back into receive as determined by the time constant of the 4538 (calculated by T=RC), which I set for two seconds (plenty of time to ensure that the transceiver does not toggle between words).

For convenience, I typically use an endless-loop tape. For long tests, I am very careful about the transmit time of my transceiver. For example, if I know that the power levels being used will cause a rapid heat-up of either the transceiver and/or the amplifier, I'll use a 60-second tape, with only about 30 seconds worth of talking, for a 50% duty cycle. If you find your system still gets unacceptably warm, try for 30% or 40% transmit time (for those who want to put up a high-powered beacon). A simple ID is usually sufficient; something like, "WB9YBM, Niles, Illinois-test" should both satisfy the FCC and provide a long enough transmission to let a mobile station drive in and out of several signal nulls. For propagation beacon applications, you may want to add information about your power level and antenna height. You can also offer a QSL in exchange for a reception report if you'd like an idea of how well your beacon is performing as well as help in studying propagation.

Since only half of the 4538 is utilized, I chose to make two independent beacons out of one circuit. There is still the need for only two ICs—the dual operational amplifier was upgraded to a quad package, keeping the project simple. If the same cassette tape is used for both beacons (each on a different band, using different antenna heights or types, or just different power levels), a stereo tape player can be used to feed both (either both tracks of the tape can initially be recorded in monaural to provide identical information to both tapes—in which case, a generic identification will be preferred—or each track of the tape can contain separate information).

No special recorders are required; any cheap play-only deck will do. If you plan to put the beacon at a relatively inaccessible spot, the primary stipulation will be a good quality tape that will not degrade too quickly with high levels of use.

### CW Beacon Applications

For a CW beacon, simply record CW on the endless loop tape and re-calculate the time constant of the 4538 as follows: If the recorded CW tone is 1 kHz, the 4538 will get triggered once every 0.001 seconds. Therefore, to avoid having the output of the 4538 give a steady output, its hang time must be longer than 0.001 seconds (1/1,000 Hz), but **short enough** to unkey at almost the same time as the CW tone on the tape. For other tone frequencies on the tape, just use the formula 1/f.

If a CW tone *and* keying are desired (to feed CW tones to a VHF FM transceiver's audio input while at the same time keying the PTT line), you can use a 555 timer set to run at 1 kHz (the approximate center of the audio passband of most transceivers and a tone many people are most sensitive to) and

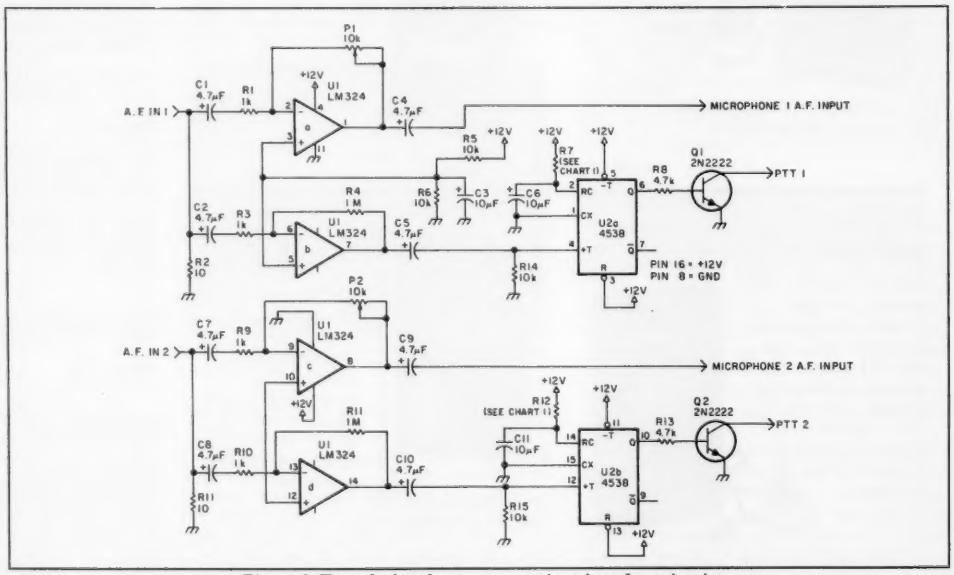


*Figure 1. Tape deck to beacon transmitter interface circuit.*

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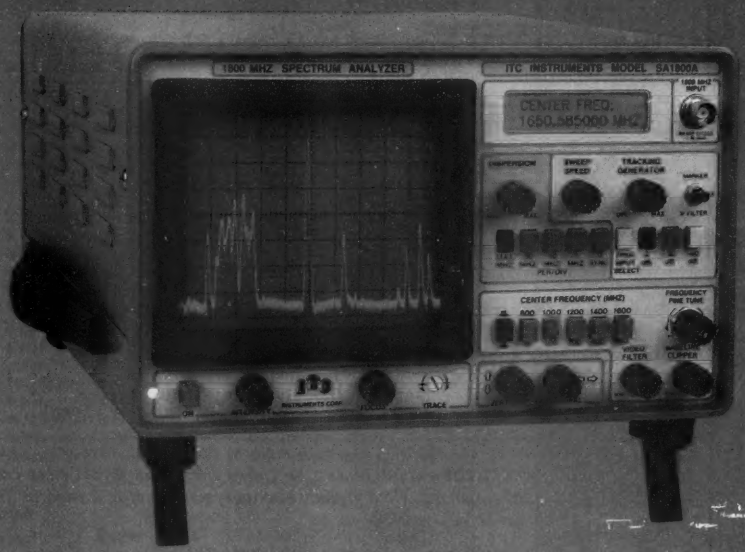


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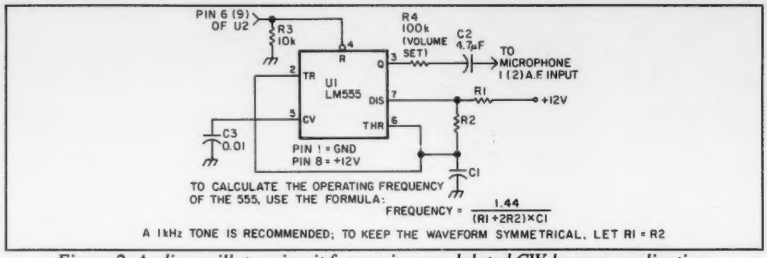


*Figure 2. Audio oscillator circuit for use in a modulated CW beacon application.*

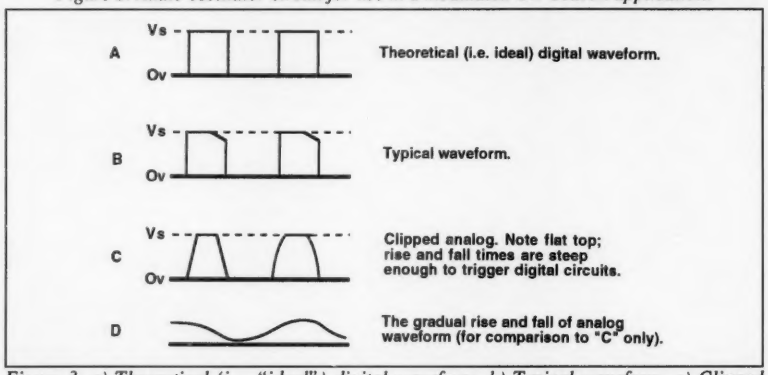


*Figure 3. a) Theoretical (i.e. "ideal") digital waveform. b) Typical waveform. c) Clipped analog. Note flat top; also, rise and fall times ("up" and "down" ramps) are steep enough to properly trigger digital circuits. d) Note gradual rise and fall of analog waveform (for comparison only to diagram "c").*

keyed from the 4538 (see Figure 2). The resistor at pin 3 of the 555 timer may be changed slightly, depending on the amount of deviation desired and the sensitivity of the transceiver's microphone input. (This schematic should look very familiar to those who have built sidetone oscillators before!)

Parts are available from Digi-Key Electronics, Mouser, Tri-State Electronics, or any other convenient mail order house.

### Bypassing and Shielding

The one point which cannot be stressed enough is the need for bypassing and shielding. Even microphones and microphone inputs labeled as "low impedance" are of a high enough impedance to pick up stray RF (in my case, it's a local commercial AM broadcaster). All input or output leads should be bypassed to ground with a 1,000 pF disc capacitor (in a few instances, I've even gone so far as using ferrite beads on leads), with the entire circuit enclosed in a metal box, and the negative side of the supply connected to the box.

### Final Adjustments

To assemble your beacon system, just hook up the interface's push-to-talk output (PTT 1 or 2) to the appropriate point on your transmitter (some HTs are keyed by using a resistor between their audio input and the interface's PTT line), hook up your tape recorder output to one of the two beacon inputs (A.F. IN 1 or 2 in Figure 1) and adjust the tape machine's audio output level until the interface circuit reliably keys your transmitter. Next, adjust the audio level into the transmitter with either R1 (for audio 1) or R2 (for audio 2).

Your beacon system should now be complete and ready for some useful equipment and propagation experiments.

**Table 1. T=RC**

| T | R | C |
|---|---|---|
| 1s. | 100k | 10 µf |
| 2s. | 200k | 10 µf |

Notes:
1. "T" is expressed in seconds, "R" in ohms, "C" in farads.
2. For values of C greater than 10µf special low-leakage caps are highly recommended.

**Parts List**

| | |
|---|---|
| U1 | LM324 IC |
| U2 | 4538 IC |
| Q1,Q2 | 2N2222 (or 2N2222A) transistor |
| C1,C2,C4,C5, C7,C8,C9,C10 | 4.7 µF tantalum |
| C3,C6,C11 | 10 µF tantalum |
| R1,R2 | 10k potentiometer |
| R3,R9,R10,R16 | 1k resistor |
| R4,R11 | 1 MEG resistor |
| R5,R6,R14,R15 | 10k resistor |
| R8,R13 | 4.7k resistor |
| R7,R12 | See Table 1 for values. |
| R17,R18 | 10 ohm resistor |
| *Optional CW Tone Oscillator (see Figure 2)* | |
| U1 | LM555 timer IC |
| R1,R2 | 10k, See Figure 2 to calculate other values (use 1k as minimum). |
| R3 | 10k resistor |
| R4 | 100k resistor |
| C1 | 0.047 µF, See formula in Figure 2 to calculate other values or frequency. |
| C2 | 4.7 µF electrolytic or tantalum |
| C3 | 0.01 µF monolithic or disk |

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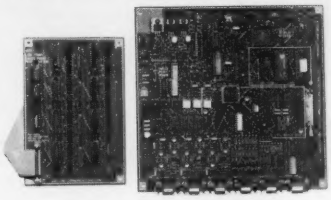

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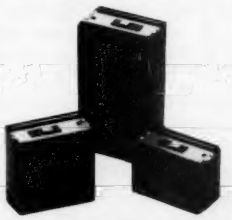

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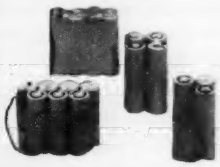

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It is a great pleasure to see an equipment manufacturer make subtle improvements to a recognized good product. It tells me that they are not satisfied with "resting on their laurels." It also indicates that there are people who feel that radio amateurs are a progressive lot who like to experiment. Not only has this company improved their product, but they did it in a manner that I feel will encourage experimentation. The evolution of this product is not apparent from the look of its case or front panel but is quite obvious from a functional point of view.

About 18 months ago, I had a chance to review a product known as the SR3 Simplex Repeater from Brainstorm Engineering in La Crescenta, California (*73 Amateur Radio Today*, May 1991, page 46). Brainstorm implemented several substantial internal enhancements to the SR3, and renamed it the SR4, then Alinco and Brainstorm joined forces. If you place the SR3 and SR4 side by side there are virtually no noticeable differences. Functionally, however, the SR4 has evolved into an extremely flexible system of integrated transceiver control.

*The SR4 multimode simplex repeater from Alinco.*

### Some Additional History

The first thing that I would like to say is that the SR4 is much more than a simplex repeater. Depending on the model of the SR4 acquired, it can also be a very capable full-duplex repeater controller. The SR4 retains all the functions of the SR3, with the addition of many more. The biggest improvement, however, is the flexibility with which the SR4 may be configured to interface with virtually any transceiver.

My review (identified above) provides a good background on this product, but for those of you who don't have access to this article, I will synopsize it here. I will then review the many enhancements and new functions offered by the SR4.

The simplex repeater is effectively a voice store-and-forward device. Hardware requirements are minimal. Only one voice-standard voice-grade transceiver and antenna are required for its operation. When the connected transceiver receives a signal, the simplex repeater digitizes its audio output and stores it in solid-state memory. When the transmitting station finishes, the simplex repeater keys the same transceiver and plays back the captured audio, effectively repeating it to any user tuned to the transceiver's frequency. There are no duplexers involved and no desense (because the receiver and transmitter are never active at the same time). Even the originating station gets to hear his or her own signal as the transmission doesn't get repeated until the originating station drops carrier. While it isn't as conducive to back-and-forth chitchat as a full-duplex repeater, it's simple to set up and quite portable. And, since the SR3 and SR4 don't use any mechanical tape transport as the voice storage media, they are also quite reliable. Older simplex repeater systems used analog tape drives which were slow (they had to rewind before the received message could be repeated) and prone to mechanical problems.

### The Physical Device

The Alinco SR4 is packaged almost identically to the SR3 (the only difference is in the front and rear panel labeling). Both units are contained in attractive, strong black metal cases 10.5" wide by 6" deep by 1.75" high. The power requirements are 11.6 to 15 VDC at about 160 mA.

The documentation is excellent. It should be realized that the SR4 is a complex radio interfacing device. Almost all analog signal inputs and outputs, whether they be control, data, or audio, may be tailored via internal adjustments. The documentation goes into considerable detail on how to optimize each parameter. This device is an experimenter's dream! Providing that the person who is initially setting this up has a reasonable level of technical competence, I cannot foresee any transceiver or device that will not work well with the SR4.

### SR4 Functionality

The SR4 comes in two models. The first, the SR4, will control one radio and functions as a simplex repeater (with voice ID and mailbox functions). The second, the SR4-D, will control two radios. As well as being a simplex repeater, it will also function as a full-duplex repeater controller. This review is applicable to the SR4-D.

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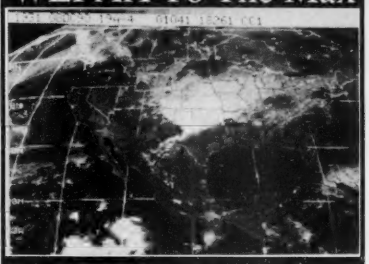

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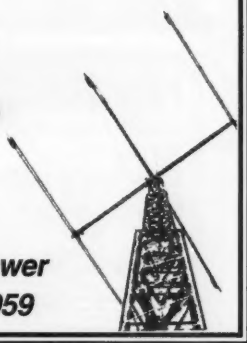

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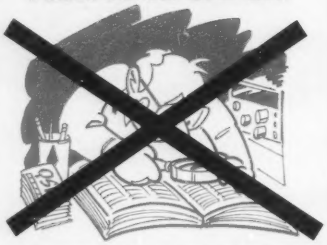

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The SR4-D is capable of several functions. The primary function of simplex repeat has several improvements over the SR3. Perhaps the most dramatic is the Receive VOX method of COR detection. It is not necessary to pick off a hardware COR from the transceiver or have the transmitting station use CTCSS. The SR4-D will generate its own carrier detection from the audio output of the connected radio. The only requirement is that the audio must be squelched. Any signal-breaking squelch will generate an active COR and either start the unit recording in the simplex repeat mode or key the second transceiver in full-duplex repeat (if that mode is selected).

The Receive VOX COR detection has three internal adjustments: attack time, hang time, and overall sensitivity. Each of these is independently controlled via internal pots. Using the SR4-D with two old Heathkit HW-2036 transceivers yielded very reliable repeating in both the simplex and full-duplex modes once the RX VOX adjustments were optimized. Unless the transmit and receive frequencies are widely separated, a duplexer is still necessary in full-duplex repeat. Another versatile capability of the SR4-D is its ability to simplex repeat on one radio while full-duplex repeating via the other. Both simplex and duplex repeat functions may be controlled via DTMF tones.

***The SR4 has a plethora of additional features that will delight the experimenter and tinkerer!***

### Voice ID and Voice Mail

The SR4 has a voice IDer that users can program with their own voice. This is done remotely via a DTMF-equipped transceiver. The activity timer, which controls the periodicity of the ID function, many be remotely DTMF programmed from one to 98 minutes. You are not limited to voice; you may use an electronic keyer and record a CW ID if desired. Voice ID messages may be recorded, played back, and erased at any time via DTMF control.

The voice mail function enables a user to store a voice (or any other audio) message for retrieval at a later time. The SR4 will only store one message at a time. When a message is stored, the SR4 generates a unique squelch tail to alert users. The message may be played as often as desired. When the voice message is erased, the squelch tail is removed.

The SR4 has a total of two minutes and 48 seconds of total audio storage capability. This is split between the simplex repeat, voice IDer, and voice mail functions. I tried both voice IDer and message functions. There are two audio sampling rates. In the low rate, the audio was a bit raspy but still quite acceptable for its intended use. In the high sampling rate position, the audio was noticeably better.

### Additional Features

The SR4 has a plethora of additional features that will delight the experimenter and tinkerer! COR detection for simplex and full-duplex repeat may be achieved by several methods: by the receive VOX method described above, by listening for a CTCSS tone (with the optional TS32P decoder available directly from Brainstorm Engineering, 2948-1/2 Honolulu Ave., La Crescenta CA 91214; Tel: (818) 249-4383), or by sensing a hard voltage level change from the connected transceiver (with the optional HW2 Hardware Carrier Detector from Brainstorm).

Hardware COR from the radio may be either a positive or negative swing and may be as small a change as 300 mV. All audio levels in and out are fully adjustable via internal pots. The SR4 is also configurable to a wide range of microphone input circuit impedances via internal jumpers.

The SR4 has a full-featured DTMF decoder. Virtually any function of the unit may be controlled remotely. Commands sent to the SR4 will be verified by an acknowledgment tone. There will be a short tone if the command is accepted and a longer one if not. The SR4 may be completely inhibited from operating or enabled from an inhibited state via DTMF control. The power saver function may be enabled/disabled.

This is a useful feature which prevents the front panel LEDs from lighting to save power during battery operation. All repeat functions of either connected transceiver may be controlled. Either radio's receiver or transmitter interface to the SR4 may be turned on or off, and either radio may also be put in or out of the simplex or full-duplex repeat mode. The roger beep/courtesy tone may be enabled/disabled and all aspects of the voice mail or voice ID may be controlled. This includes recording, playing and clearing messages and voice IDs. The SR4 may also be inhibited from passing DTMF tones on the air via its repeat function. Finally, the SR4 has an auxiliary output which may be used to control a relay or similar device.

Soon to be released features are a multi-user voice mail system, 11 minutes of digital storage time and a simplex and duplex autopatch.

Writing a review for a device like the SR4 is difficult at best. I don't believe that any two individuals will use it in the same way. Reading the SR4's manual and experimenting with the unit itself will start the creative juices flowing. It is an excellent addition to your club's repeater or your home station. 73

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# HOMING IN

## Radio Direction Finding

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### Computers Point the Way

Living in Southern California has its good and bad points, but one big advantage for hams is being able to go on hidden transmitter hunts all year long. Radio direction finding (RDF) enthusiasts in northern states and Canada have a few months of cold weather and icy roads ahead, so many clubs there will not be holding these contests (called foxhunts and T-hunts) until spring.

That doesn't mean you should forget about this part of ham radio, however. Now is the time to plan and build a better RDF setup, in anticipation of the thrill of victory when hunts resume. What will your new secret weapon be?

The "radar scope" display, described in "Homing In" for October and November 1992, generated lots of response. Readers like the two-dimensional view of the hidden signal, but some have had trouble finding suitable storage oscilloscopes. Furthermore, these scopes are bulky and difficult to power up in a vehicle.

Why not use a computer screen for the readout device? A laptop portable is small and lightweight. It works from its own batteries, or perhaps 12 volts from the vehicle. Best of all, the computer can "crunch" the data to aid in finding the most accurate bearing and navigating to the hidden T.

#### Heads Up!

Jerry Boyd WB8WFK of Albuquerque, New Mexico, is a pioneer in computer-assisted mobile RDF. When I first met Jerry in October 1991, he had installed a continuous-turning potentiometer at the base of the mast for his four-element 2 meter T-hunting yagi (Photo A). It drove a dash-mounted meter that gave him a "heads-up" indication of antenna pointing direction.

This remote azimuth indicator is an easy weekend project. Figure 1 shows the schematic for it. Jerry used a surplus Bourne's precision linear taper pot (R1). U1 can be any op amp IC that works as a voltage follower at DC. Regulator U3 is used as an active voltage reference. R3 adjusts its output to +3.4 volts (corresponding to 340 degrees), measured at TP1.

Jerry's azimuth pot has 340 degrees of winding and a 20-degree dead zone. He says, "Between 340 and 359 degrees the arm of my pot goes open circuit. R6 prevents the output of U2 from floating when the pot is in this dead zone." Align the indicator so that when the antenna points forward, the pot is at the 180-degree setting and output voltage at TP2 is 1.8 volts. This puts the dead zone behind you where it has the least effect when T-hunting. Calibrate the meter by setting R8 for a 180-degree reading on M1 at this R1 setting. If you are not using a 100 microampere meter movement, change the values of R7 and R8 accordingly. Movements from 50 microamperes to 1 milliampere can be used with appropriate changes in these resistors.

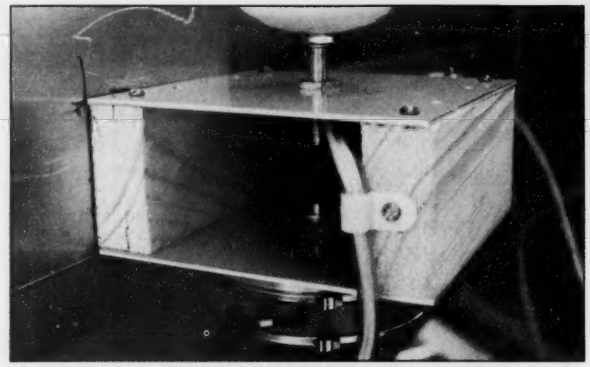

*Photo A. This is how WB8WFK attaches the bottom of his mobile antenna mast to the azimuth-sensing potentiometer. The assembly mounts to the inside of the driver-side door.*

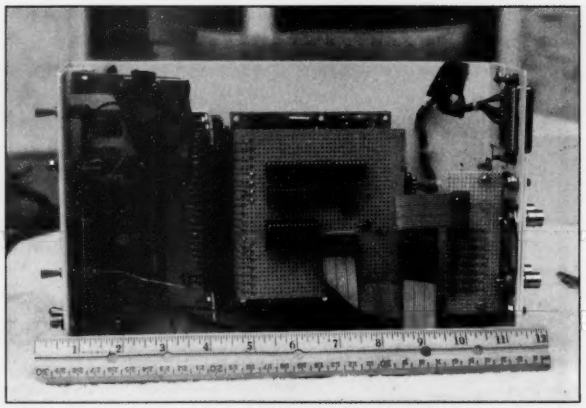

*Photo B. Interior view of the interface box containing the MUX, A/D converter and Micromint computer board. BNC jacks on the rear are analog data inputs. (Photo by WB8WFK.)*

#### Going Digital

Today, WB8WFK's huntmobile boasts an integrated digital bearing-taking, storage, and display system. The nerve center of the system is an interface box (Photo B) that includes a home-brew eight-channel analog multiplexer (MUX), analog-to-digital (A/D) converter, and a Micromint Z8 single-board computer (Figure 2). Analog signals representing antenna azimuth, S-meter, and RF attenu-

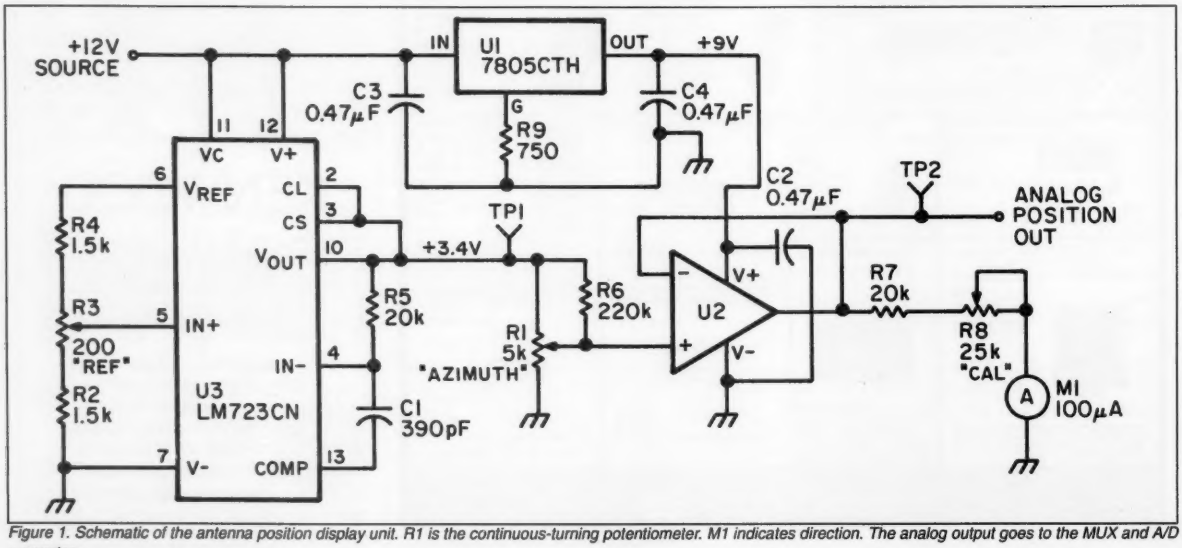


*Figure 1. Schematic of the antenna position display unit. R1 is the continuous-turning potentiometer. M1 indicates direction. The analog output goes to the MUX and A/D converter.*

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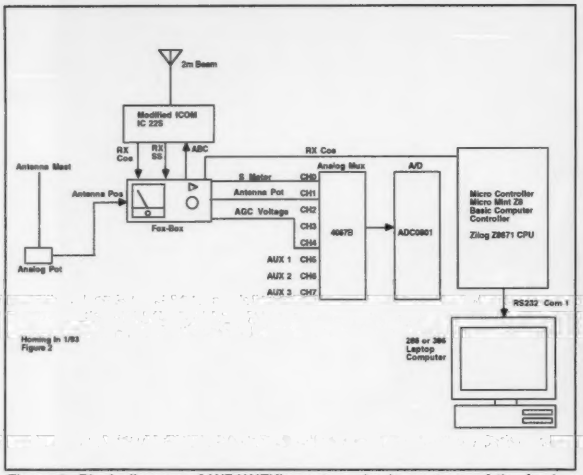


*Figure 2. Block diagram of WB8WFK's system. Analog outputs of the fox-box are digitized and then processed by the controller and laptop computer. Extra MUX channels are available for inputs from a flux-gate compass and digital shaft encoder.*

*Photo C. WB8WFK's car is ready for the hunt. The analog fox-box and digital interface unit are on the dash. The computer (protected by pillows) has replaced a human in the passenger's seat. (Photo by WB8WFK.)*

ation go from the fox-box to the MUX. The Z8 takes the digitized data and transmits it to a PC-compatible portable computer via the RS-232 port. The computer is programmed to use the serial azimuth and signal strength data to compute and display polar plots (Figure 3).

"Ed James KA8JMW loaned me a 386 laptop (Photo C) for the display unit," Jerry says. "But even with this fast computer, the plotting is not done in real time. I push a button to trigger a data acquisition. The program takes 256 samples of antenna angle and signal strength and stores them in an array. It samples at about 10 times a second. Then it quits sampling, draws the plot, and computes the best bearing. "Next, I have the option of scaling the plot. Say the S-meter reading was low, so the trace was small. I can enter a scale factor to expand the plot to full size. I'm thinking of making the software compute the scale factor automatically."

Like most VHF T-hunters who use beams, WB8WFK turns his mobile antenna mast manually. The 25-second data acquisition time gives a number of options. He can swing the antenna through a full circle at about 2 rpm to get a complete 360-degree plot showing all incoming signal components. This includes the direct signal, any multipath signals, and any noise sources (Figure 4). Fluctuating signals and noise show up as a "spikey" display compared to steady signals, which produce well-rounded lobes (Figure 5).

***"Fluctuating signals and noise show up as a 'spikey' display compared to steady signals, which produce well-rounded lobes."***

On some hunts there is only one apparent signal direction, but the amplitude fluctuates due to nearby moving objects, airplane flutter, or power changes by the transmitter hider. When that happens, Jerry sweeps back and forth across the signal when taking data, instead of turning the antenna in a full circle. This builds up multiple traces in the direction of interest and improves the accuracy of his bearings.

Jerry adds, "One of the software features is that it walks through the data array to find the signal peak and the corresponding angle to the peak. On the screen I see the polar plot, plus a status panel with best bearing details on the side.

"I used it on a real hunt Sunday. It shows direct signal and reflections real nicely. What really surprised the other hunters was that after the hunt I could play back the bearings. I have a feature in the software that saves data to a disk file for later review."

### It's All in the Software

"The Z8 control program is written in Tiny Basic and is downloaded to the Z8 by the DIGDF program on the PC," Jerry says. "The program for data display is in Microsoft Quick Basic 4.5. On my old XT it takes 45 seconds to do the plot. On the 386 laptop, it's five seconds." Jerry says that other computers besides IBM compatibles could be adapted to this system. "Ed has a Radio Shack Model 100 and we're thinking of seeing if we can make a version of the software that runs on it, using an X-Y plot of signal strength versus azimuth instead of a polar display. Model 100s don't have the screen resolution to do a polar plot, but they're real cheap at hamfests."

Next month's "Homing In" will have more details on the software features, plus schematics and parts information for the interface box. Jerry's strong signal attenuation scheme will also be described.

I'll bet other readers are working on digital processing for their RDF equipment. If so, I'd like to hear about it. Write and tell me what you are doing. Better yet, get out the camera, take some pictures, and send them to me. Let's share ideas.

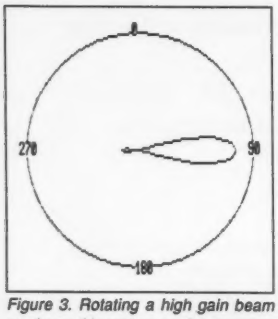


*Figure 3. Rotating a high gain beam produces this pattern on the computer screen when there are no fluctuations, reflections, or multipath. (Of course, this never seems to happen on an actual hunt!)*

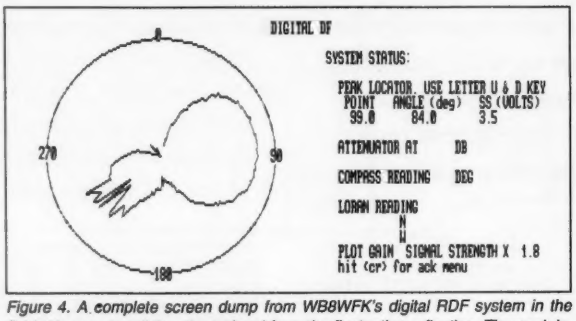


*Figure 4. A complete screen dump from WB8WFK's digital RDF system in the field. It's easy to tell the direct signal from the fluctuating reflection. The peak locator shows that maximum signal is coming from 84 degrees with respect to the vehicle heading. The S-meter reading was multiplied by 1.8 for a full-size plot. Attenuation, compass, and LORAN indications have not been fully implemented into this software version.*

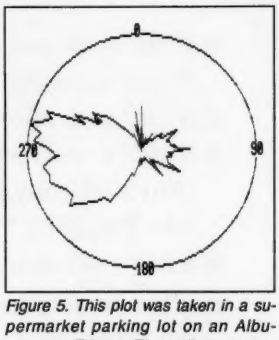


*Figure 5. This plot was taken in a supermarket parking lot on an Albuquerque T-hunt. The spikes at zero degrees represent noise from power lines ahead of the vehicle. The hidden T is to the left and there is reflected signal from the right.*

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# HAMS WITH CLASS

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*Photo A. Eighth graders Matt KB2OJI and Bianca are examples of children who love to get involved with local, national and international issues through ham radio.*

## Do You Have the Write Stuff?

Every time a new issue or controversy comes up that affects our lives in some way, we as American citizens have the right and the obligation to let our elected officials know what our points of view are on the matter. Whenever an important new rule is being proposed that affects the amateur radio community, most of us have strong feelings pro or con on the issue before us. Usually, some member of an active radio club will organize an effort to make it real easy for the membership to express their opinions by signing a petition or by getting a massive letter-writing campaign going.

As an amateur radio teacher in an intermediate school, I like to seize upon these opportunities to teach a civics lesson and a language arts lesson as well. After we discuss the issue and the children do the required research to present their arguments to the rest of the class, we talk about what our best options are to get our opinions across to the people with the power to enact legislation and to make changes.

In 1990, the United States Postal Service handled about 60 billion first-class letters and packages. That means that the average American household sent about 620 letters that year. Were any of them sent to a senator, representative, FCC Commissioner, or other government official? In most households, the response to that question would be "no."

It's important for children to know that writing to Congress or other branches of the government is still one of the most effective things that a citizen, as an individual, can do. According to the Office of Legislative Information and Bill Status, thousands of bills get introduced during each session of Congress. By speaking out on any of these bills, you automatically increase your "political clout." Many members of Congress consider opinions expressed in a letter to represent at least 100 votes.

### Guidelines for Writing to Congress

The children always enjoy writing their opinions in a letter when the point about its importance is made clear to them. I use the following guidelines with my classes to ensure the most effective response.

When writing to Congress, personal letters are preferable to preprinted cards. A veteran lobbyist says that, "Handwritten letters show that a person has taken the time to think about an issue and has a viewpoint on it. The more people write out of their own convictions, the more likely they are to get a response."

Write about one topic at a time. Make your point and don't confuse the issue with other extraneous information.

Letters that are short and to the point are more likely to get read. Legislators often use letters simply to get a count of the number of people who support or oppose different bills.

In your first sentence, state that you oppose or support a specific bill or issue, so it will be easy to tell which side you're on.

Postcards are easier to send and easier to read.

If you're referring to a bill, make sure you have the right number and title. This is very important due to the large number of bills that get introduced every year. You can get this information by calling your local Congressional office. Put some kids to work on this aspect of the preparation and research. It's good experience for them to start to learn their way around their own government.

State your case. Show that you understand the issue and explain how it affects you, your family, and your community.

If it's appropriate, send a "thank you" letter once the issue has been decided. According to one expert, for every 100 to 250 letters that legislators receive in a week, only about two are "thank you" letters. If you send a thank you letter, you may stand out enough that they'll remember you the next time you write.

One of our goals as educators, no matter what subject area we teach, should be to make sure that our students know the importance of being well informed, and then know what acceptable channels to go through are available to let their voices be heard. Teachers using amateur radio in their classes have many unique opportunities to teach about the responsibilities that go along with being a good citizen of their community, their state, their country, and of the planet. The nice thing about it is that there's always something going on somewhere either locally, nationally, or internationally that can lead into a great classroom lesson.

Besides liking the idea of making their own statements, my classes eagerly await the reply comments. Everyone in the class gets excited when official-looking correspondence comes to the school, addressed to them.

If you've had some interesting experiences getting your classes involved with the system of how government works, please write to me so we can share the ideas. 73

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# CARR'S CORNER

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*Falls Church VA 22041*

## Using The Passive Double-Balanced Mixer (DBM)

The *double-balanced mixer* (DBM) is a terribly useful RF electronic component. It can be used in receivers, transmitters, test equipment and many other applications. It provides good mixing action with little of the hassle and headaches that accompany active mixers (transistors, ICs, etc.). The DBM is truly a versatile little beastie.

Figure 1 shows the generic circuit for the DBM. The mixing action is caused by a diode ring (D1 through D4), which is not, by the way, the same thing as a full-wave bridge rectifier (look at the diode directions). Coupling into and out of the circuit is provided by the RF input (RF), local oscillator (LO) and intermediate frequency (IF) ports; these are coupled via broadband RF transformers.

### The Mini-Circuits SRA Series

While it is relatively easy to make working DBMs using signal diodes and toroid transformers, it's just as easy to buy high quality parts from a source such as Mini-Circuits (P.O. Box 350166, Brooklyn NY 11235-0003; 718-934-4500). Their SRA and SBL series DBMs are used extensively in ham construction projects shown in various publications over the years. The SRA-1 works from 500 kHz to 500 MHz (both LO and RF), and produces an IF output of DC to 500 MHz, depending on the LO and RF frequencies; the related SRA-1-1 works down to 100 kHz. Another model, SRA-2, works over the range 1 to 1,000 MHz (RF/LO), and produces IF outputs in the range 500 kHz to 500 MHz. The SBL series is similar to the SRA, but they are somewhat smaller. Prices in small quantities are in the $15 range (consult the Mini-Circuits catalog for current pricing of any particular model).

The SRA-x devices come in a small, shielded metal housing that is 0.4 inches tall, 0.4 inches wide, and 0.8 inches long. It has eight pins on the bottom side, spaced 0.100 inches apart (see Figure 2). The pin spacing is the same as for most dual-inline package (DIP) integrated circuits, so the SRA series DBMs can be used on the standard perforated board that many hams like to use for construction. The number 1 pin indicated by the insulation around the pin is blue in color. All other pins are either connected to the case or embedded in gray or white insulation material. The pin numbers are arranged in zigzag order so that all of the odd numbered pins (1,3,5,7) are on the same side, and the even numbered pins (2,4,6,8) are on the opposite side.

For the SRA-1 and SRA-1-1, which are probably the most popular with ham operators, the following pinouts are found:

| | |
|---|---|
| *Local oscillator:* | 8 |
| *RF input:* | 1 |
| *IF output:* | 3,4 (must be tied together) |
| *Case ground:* | 2 |
| *Other ground:* | 5,6,7 |

The SRA-2 is similar, except that the RF input is placed on pins 3 and 4 (tied together), while the IF output is taken from pin no. 1. There are other models than SRA-1, SRA-1-1 and SRA-2, and these may have different pinouts than shown here. Consult the Mini-Circuits data for particulars.

The electrical performance of the SRA series DBMs is impressive for such low-cost parts. Isolation of the LO-RF circuits is on the order of 25 dB at the high end of the frequency range, and 50 dB at the low end. Similar numbers are found for LO-IF isolation as well. They use a +7 dBm LO signal, and can handle up to +1 dBm RF signals; these translate to 5 mW (15.8 mV) and 1.26 mW (7.9 mV) dissipated in a 50-ohm resistive load, respectively. The standard RF system impedance (50 ohms) is used for the SRA-series inputs and outputs.

Conversion loss in the passive mixers ranges from 6.5 to 8.5 dB, and this is easily made up with a simple amplifier if it can't be tolerated. In fact, the Mini-Circuits MAR-xx series of MMIC amplifier devices can easily be used for this purpose. One of Mini-Circuits other products is a series of active double-balanced mixers, in a similar case as the SRA series. These devices place an amplifier and DBM inside the same housing. The UNCL-X1 is similar to the SRA-1, except that it provides an output buffer for the IF port. The conversion gain (not loss) is 0.5 to 1 dB over the 1 to 500 MHz frequency range. The UNCL-R1 places the amplifier ahead of the RF port of the mixer, so it can accommodate RF signals up to -10 dBm, but also those that are considerably—10 dB—weaker than will operate with the SRA-1. Conversion gain for the UNCL-R1 is 2 to 5 dB. The UNCL-L1 places the amplifier ahead of the DBM LO port, so it can accommodate weak LO sources. Conversion loss (not gain) is on the same order as for the SRA-1. The power requirements for these devices are similar: 12 VDC at 35 mA or so.

Figure 3 shows a typical "generic" circuit for the SRA-1 and SRA-1-1 mixers. The RF, LO and IF ports are protected by DC-blocking capacitors. These capacitors are necessary because the DBM must often operate in circuits that have a non-zero DC level, or with signals that have a considerable DC component. The DC can burn out the windings of the input and output transformers. Of course, if there is no possibility of that happening in your particular application, then don't worry too much about the capacitors. In general, 0.01 µF disk ceramic capacitors will work in the HF region, while 0.001 µF (or even 100 pF) will work in the VHF region.

Notice that the two IF pins (3 and 4) are tied together. This connection is necessary, or else the device won't work properly. Also connected together are the ground pins (2, 5, 6 and 7). All of these pins must be grounded for proper operation, even though pin no. 2 is only the case ground (it serves to shield the innards of the device).

Any number of output circuits can be accommodated, so long as they

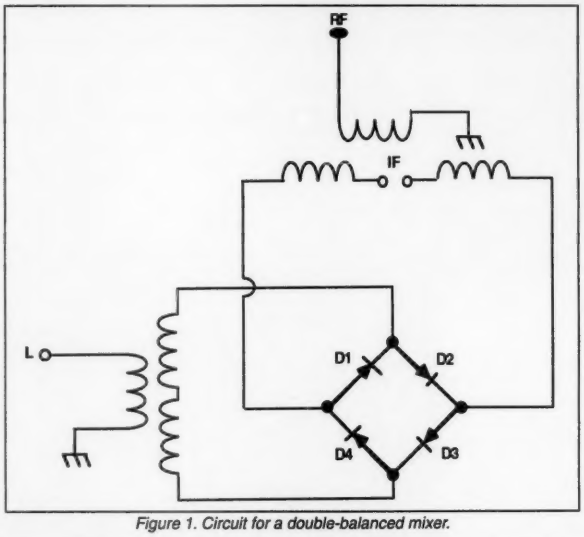


*Figure 1. Circuit for a double-balanced mixer.*

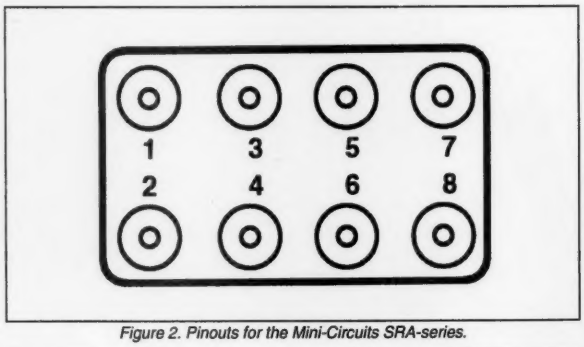


*Figure 2. Pinouts for the Mini-Circuits SRA-series.*

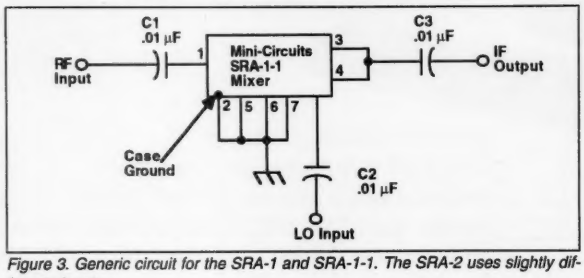


*Figure 3. Generic circuit for the SRA-1 and SRA-1-1. The SRA-2 uses slightly different pinouts.*

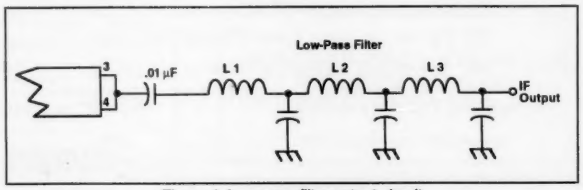


*Figure 4. Low-pass filter output circuit.*

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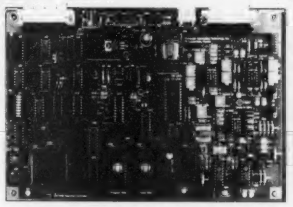

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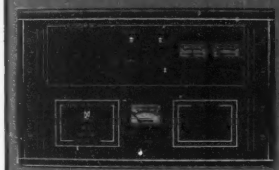

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are a reasonable match to the 50-ohm impedance of the SRA-1 and SRA-1-1 devices. A double-balanced mixer has some interesting properties. For example, it is more free of harmonics than other mixers, and it suppresses the LO and RF signals in the output. Thus, the spectrum of the output signal consists of the sum and difference (RF +/- LO) IF signals. A frequency-selective circuit will determine which one gets through to the rest of the circuits. One popular output circuit is a low-pass filter (Figure 4) that will pass only the difference signal. Alternatively, a high-pass filter will pass only the sum signal. This circuit allows considerable latitude, so long as the desired output frequency is within the passband of the filter. For specific IF frequencies (e.g. 455 kHz, 10.7 MHz, 8.83 MHz) used in receivers, a tuned bandpass filter circuit is needed.

**A Useful DBM for the Workbench**

Like many amateurs who have an electronic workbench in the basement laboratory, I have a goulash collection of signal sources bought new, bought used at hamfests, home-brewed, or obtained from goodness knows where in my 33 years as a ham. In order to obtain certain specific frequencies, however, I sometimes have to resort to using a DBM. Photo A shows my "test DBM." It consists of a Mini-Circuits SRA-1-1 mounted in an ITT/Pomona Model 2417 box. The circuit is the same as Figure 3, except that for stability I placed 1 dB Mini-Circuits' fixed attenuators in series with the RF, LO and IF ports. These attenuators keep the impedance stable, even when the source or load impedance is either not 50 ohms, or varies. The variation does not affect the SRA-1-1, but has affected some circuits that I've been working on. The added loss is reasonable for the stability gained.

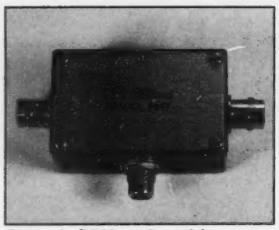

*Photo A. DBM packaged for use on testbench.*

By the way, my new book, *Receiver Antenna Handbook* (HighText Publications, Inc., 7128 Miramar Road, #15, San Diego CA 92121) is about ready for publication. Although it deals with receiver antennas, there is much material for ham operators as well. My other antenna book, *Practical Antenna Handbook*, is more in tune with hams, and is available from TAB/McGraw-Hill (Blue Ridge Summit PA 17294) for $21.95 (use catalog number 3270).

Number 14 on your Feedback card

# HAM HELP

## Your Bulletin Board

*We are happy to provide Ham Help listings free on a space available basis. To make our job easier and to ensure that your listing is correct, please type or print your request clearly, double spaced, on a full 8 1/2" x 11" sheet of paper. You may also upload a listing as E-mail to Sysop to the 73 BBS 73 MAG Message Area #4. (2400 baud, 8 data bits, no parity, 1 stop bit. (603) 924—9343). Use upper- and lowercase letters where appropriate. Also, print numbers carefully—a 1, for example, can be misread as the letters 1 or i, or even the number 7. Specifically mention that your message is for the Ham Help Column. Please remember to acknowledge responses to your requests. Thank you for your cooperation.*

We wish to announce that Roxanne Delmage VE3VON, and Craig Delmage VE3KKU, are the current QSL Managers for 9L3BM.

I recently purchased a Hallicrafter SX-111 and HT-37 (matching receiver and transmitter). I am looking for a manual and/or schematic for this 1960s equipment. I will pay for copies. *Brian Angel, 825 1/2 Wilson Ave., Ames IA 50010. (515) 232-7817.*

Does anyone know where I can get info on the duties and responsibilities of Merchant Marines Officers? I'll take books, tapes, or any other educational materials. Please write and let me know what you have and how much $$ you want for it. *Ed Melanson, RFD #2, Box 510, Thomdike, ME 04986.*

Help! I just purchased a Radio Shack Model 102 laptop, and I'm looking for software, hardware and publication sources. I could especially use ham software, a spreadsheet, modem cable, printer cable. Please write or call, *Brent Putnam N8UBD, 12110 Mayfield Rd. #6, Clevela OH; (216) 721-2019.* Or e-mail to *bwp2@po.cwru.edu* on college internet.

Can anyone help me locate Brian Key N5LNL? This station is with the military somewhere in Venezuela, not at the call book address. N5LNL was my first CW contact but I cannot find the proper address to send QSL. If you have any information, please contact *Gene Kohring N8QWM, 1647 Millville-Shandon Rd., Hamilton OH 45013-9611.* Thank you.

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I am looking for the diagrams and user/service manuals for my surplus communications receivers: RACAL HF 1-30 MHz, Model 1220 DRG#41880/D Serial #1551; RACAL VLF Converter NC.RA-6337A, Serial #260; CEI VLF-354 1-600 kHz Receiver, Serial #7. I will compensate for Xerox/mailing. *Yuri Dzyuba VE2XLT (ex UB5LT), 3150 Rosemont #15, Montreal PQ H1Y-1M5 Canada.*


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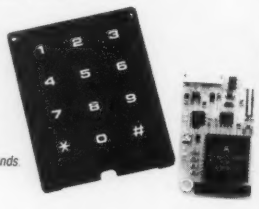


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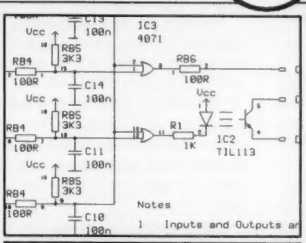


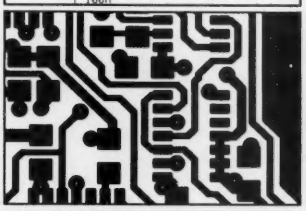

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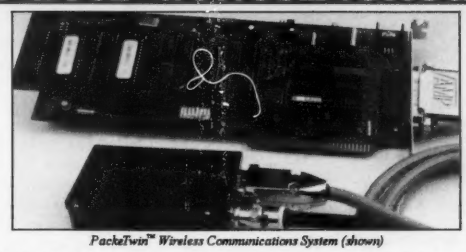

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### TV Camera Lighting

The minimum light sensitivity of TV cameras has improved dramatically in the past few years. I used to have a few bright floodlamps in my shack in order to provide enough light for my old color TV camera. It worked great outdoors in bright sunlight, but was dreadful inside. It needed 50 lux minimum light level to produce a good image. The "lux" rating is a light level corresponding to one lumen per square meter (approximately the light produced one meter from a single candle).

Even some of the newer cameras still require some attention to the lighting in your shack to come up with a decent image. Until now, TV cameras that were more sensitive than your eye were unaffordable.

#### The GBC CCD-200

I recently obtained a new offering from CCTV Corporation, 315 Hudson St., New York, NY 10013; (800) 221-2240, (212) 989-4433. Their new model CCD-200 B/W TV camera has some eye-opening specifications. This camera is somewhat smaller than a pack of cigarettes, has an automatic electronic shutter and includes a built-in microphone. The most amazing parts of it are the light sensitivity rating of 0.02 lux and the special $204.50 price for *73* readers!

I first tested out the camera in a room with somewhat dim lighting: just one table lamp. I was amazed to find that everything in the room appeared brighter on the TV screen than it appeared with my eyes. I pointed the camera through a doorway into a dark room; the camera picked up objects that I could barely even see. The resolution was excellent (425 lines) and the microphone worked well. The wide range of the electronic shutter allowed me to look at the darkest portion of the room and compensate quickly when I pointed it directly at the lamp. You can even point this camera directly at the sun without ill effect (something you couldn't do in the old days with vidicon tubes).

#### Build Your Own Nightscope

I noticed that the CCD-200 was very sensitive to the infrared spectrum. It could detect the hot tip of a soldering iron, see blood vessels underneath my skin and see the pulsing infrared output of my VCR's remote control (invisible to the naked eye). I turned out the light, and found that the output of the remote control could illuminate a completely dark room when viewed through the TV camera.

I've always dreamed of owning my own Nightscope. It would be a real thrill to actually see in the dark. A Nightscope uses a high-intensity infrared (IR) source to illuminate the scene and an IR-sensitive detector/light amplification scheme that views the area. It's all a very complicated and *expensive* affair occasionally obtainable through military surplus outlets.

The prospect of building my own Nightscope prompted me to run down to my local Radio Shack and browse through their LED section. I found an appropriate candidate in their high-output infrared LED (model #276-143b). I grabbed a handful of these and headed back home to the workbench. I mounted two of these on a breadboard, along with a current-limiting resistor for each LED (see Figure 1). Just attach the LED board to the power supply you use for your TV camera. For a 9-volt supply use 270-ohm resistors; for 12 volts or more use 470 ohms. Each LED draws about 25 milliamps.

I put the LED board into a small plastic project box and attached it to the top of the CCD-200 with velcro. I switched off the room light and turned on the TV camera/infrared LED system. I was amazed! It was as if the two LEDs were headlights illuminating whatever I pointed the camera at. Even though I was sitting in total darkness, I could clearly read labels and see objects up to six feet away on my TV monitor. To make sure that my TV set wasn't providing any illumination, I checked out the TV camera/LED system in a dark hallway with the same results. The only visible indication that the LEDs are operating is a very dim red glow if you stare directly into the tops of the LEDs in a totally dark room.

To light up a larger room, you may want to add more LEDs to the system, but I found that even just one LED worked fairly well.

To make a portable Nightscope, just add a small portable TV monitor (such as the Radio Shack Pocketvision 26, RS# 16-163) and a battery pack; you can now literally see in the dark.

Although it is a visible light source, you can really light up a room with one of the newer jumbo red LEDs. A good one is the jumbo 5000 (Radio Shack# 276-086).

#### Security Applications

The security applications of this system are intriguing. You can mount the CCD-200 and the LED array in your repeater site, your ham shack or your clubhouse and observe any intruders via an ATV link without their being aware of the camera (after all, everything will appear totally dark to their eyes). If the intruders use a flashlight, the whole room will light up like it was broad daylight.

You can have the infrared ATV link (and VCR) come up whenever a security motion sensor (or magnetic window/door sensor) is activated. Instead of your normal ATV repeater ID, you'll have a bird's-eye view of the intruders.

*Photo A. The CCTV Corporation CCD-200 low-light level B/W TV camera.*

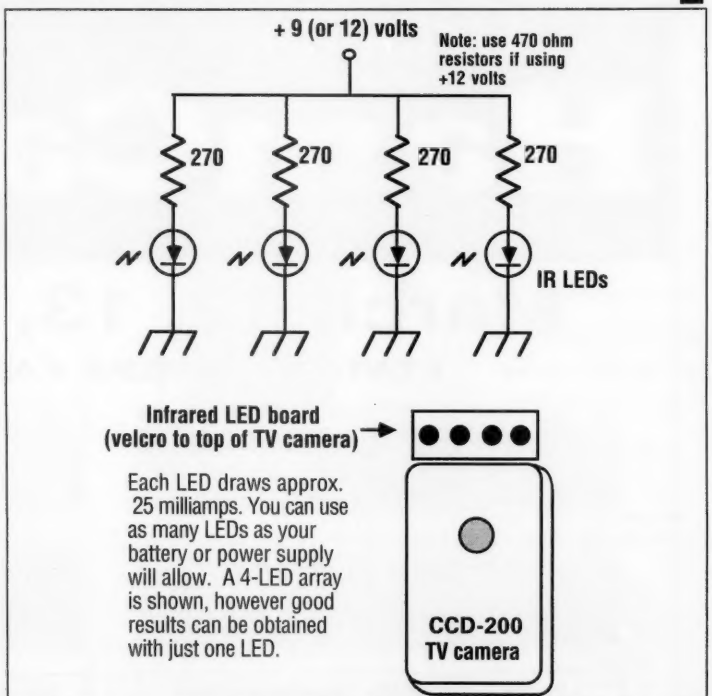
+ 9 (or 12) volts
Note: use 470 ohm resistors if using +12 volts
270
270
270
270
IR LEDs
Infrared LED board (velcro to top of TV camera)
Each LED draws approx. 25 milliamps. You can use as many LEDs as your battery or power supply will allow. A 4-LED array is shown, however good results can be obtained with just one LED.
CCD-200 TV camera

*Figure 1. An array of high-output infrared LEDs mounted above the CCD-200 TV camera will provide enough illumination to light up a small room. Since the output is all in the infrared spectrum, the room will appear completely dark with the naked eye. For 9-volt operation use 270-ohm resistors; for 12 volts use 470 ohms.*

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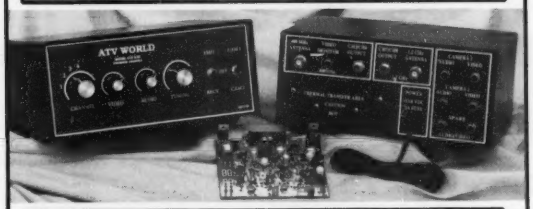


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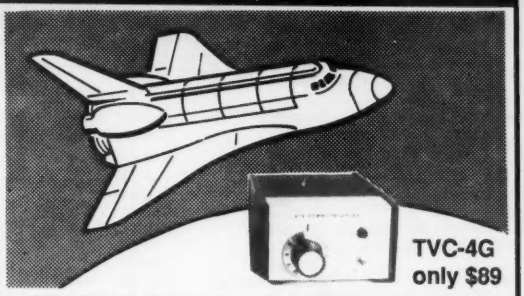

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# 1992 ANNUAL INDEX

| Subject/Article | Description | Author | Issue | Page |
|---|---|---|---|---|
| **Amplifiers, Audio, Preamp** | | | | |
| 2 Meter FET Amplifier for Your Handheld | Construction | AA4AW | OCT | 20 |
| 10 GHz amplifier | Avantek | WB6IGP | SEP | 80 |
| Audio amplifier | Construction | WB8VGE | DEC | 80 |
| Common Audio and Speaker Bus | Construction | W6WTU | SEP | 36 |
| Five-Component Wideband Amplifier | Construction | K9EYY | FEB | 12 |
| Gain | Classes of amplifiers | KB1UM | JAN | 50 |
| GaAsFET Preamp Sequencer | Construction | WZ1V | MAR | 8 |
| LiTZ decoder | Emergency alert touchtone decoder | KA5RZI, N7IOB | DEC | 30 |
| Noise Remover | Circuit | K8MKB | NOV | 12 |
| Tape recorder | RF problems | KB1UM | MAR | 66 |
| Touch-Tone Squelch | Audio/speaker control/ construction | VE3RGW | JUN | 20 |
| **Antennas** | | | | |
| 2m Yagi | Construction | W3HMI | SEP | 30 |
| 6-Band Linear Trap | Construction | KB4ZGC | JUL | 14 |
| All-Band HF Mobile Antenna | Construction | KC4TMT | NOV | 18 |
| Arrow Antenna | Construction | KAØVFF | APR | 10 |
| Baby Loopy | Construction | NH6XK | OCT | 34 |
| Beach Brawley Boomer | Construction | NH6XK | DEC | 48 |
| Compact-A-Loop | Construction | G2BZQ | AUG | 18 |
| Copper Cactus J-Pole | Construction | KE7AX | FEB | 9 |
| Direction finding | MFJ-1730/J construction | KØOV | MAY | 54 |
| Direction finding | Quads | KØOV | JUL | 54 |
| Direction finding | Suggested antennas | KØOV | JUN | 74 |
| Flower Pot Special | Construction | N1GPH | APR | 18 |
| Indoor Vertical Dipole | Construction | W3JIP | JUL | 8 |
| Log Periodic Dipole Array | Construction | N2KLK | MAY | 14 |
| Longwire Antenna | Construction | NH6XK | SEP | 18 |
| Loop antenna | Construction | W2IMB | OCT | 28 |
| Monoband Yagi for 20m | Construction | AB4GX | APR | 30 |
| Noise Reduction Using Broadband Active Whip Antennas | Construction | WD4PLI/6 | OCT | 38 |
| Portable | For satellite contacts | WA5ZIB | AUG | 66 |
| Plumber's Delight | Construction | KB6EPO | APR | 16 |
| PVC Cubical Quad | Construction | KG5BI | FEB | 38 |
| The Raser | Construction | W2OZH | SEP | 8 |
| Simple Rooftop Vertical | Construction | NØLRF | SEP | 60 |
| VE3CYC's Wire Beam | Construction | VE3CYC | JUN | 16 |
| Wideband RF Baluns | Description | K8IHQ | SEP | 20 |
| **ATV, FSTV, SSTV, Video, Balloons** | | | | |
| ATV | Balloon recovery/ direction finding | KØOV | APR | 66 |
| ATV | Balloons-comparison to satellite communications | WA5ZIB | JUN | 46 |
| ATV | BARC; Logan, UT | WB8ELK | NOV | 46 |
| ATV | Contest | WB8ELK | OCT | 80 |
| ATV | Downconverter/construction | W9NTP | MAR | 22 |
| ATV | Eclipse 1 flight | WB8ELK | APR | 52 |
| ATV | NTSC repeater | WB8ELK | JUN | 54 |
| ATV | Repeaters | WB8ELK | DEC | 56 |
| ATV | Rockets | WB8ELK | JUL | 56 |
| ATV | SPECTRA III | WB8ELK | SEP | 66 |
| ATV | Touch-Tone controller/ construction | WB8ELK | JAN | 58 |
| ATV | Touch-Tone decoder/ construction | WB8ELK | FEB | 64 |
| ATV | Tournament of Roses Parade | WB8ELK | MAR | 56 |
| ATV | Transmitter, Part I— construction | KA2CWL/K2MQJ | AUG | 22 |
| ATV | Transmitter, Part II— construction | KA2CWL/K2MQJ | SEP | 50 |
| ATV | Wisconsin flight 12/91 | WB8ELK | MAY | 56 |
| ATV/SSTV | Video digitizers | WB8ELK | AUG | 50 |
| SSTV | ViewPort VGA | KA2PYJ | AUG | 8 |
| **Computers and Software** | | | | |
| 8-Channel A-to-D Converter (computer interface) | Construction | N8KDD | JUL | 40 |
| Control Your Station by Computer | Construction | WK2S | MAY | 30 |
| DesqView | RTTY | WA3AJR | AUG | 60 |
| The Lappack | Portable power supply for laptops | W5VBO | MAR | 52 |
| Morse code program | For IBM PC | WA3AJR | MAY | 78 |
| Packet | Internet-to-AX.25 | N1EWO | DEC | 74 |
| Packet on the MAC | Construction | KD6CMT | OCT | 8 |
| PBBSs | Description | N1EWO | AUG | 62 |
| PUFF design program | Microwave circuits | WB6IGP | MAY | 74 |
| PUFF design program | Microwave circuits | WB6IGP | JUN | 64 |
| Software sources | RTTY | WA3AJR | MAR | 76 |
| ViewPort VGA | SSTV | KA2PYJ | AUG | 8 |

| Subject/Article | Description | Author | Issue | Page |
|---|---|---|---|---|
| **Digital Modes: Packet, CW, RTTY, AMTOR, etc.** | | | | |
| CW | Copperback Beetle/ construction | KI5AZ | MAY | 20 |
| CW | Morse code computer program | WA3AJR | MAY | 78 |
| Digital ALC | For transmitters/ construction | N7APE | AUG | 36 |
| Digital radio | Glossary | N1EWO | NOV | 62 |
| Digital technology | Theory/general description | KB1UM | JUN | 70 |
| Digital technology | Theory/general description | KB1UM | JUL | 70 |
| Hand-held packet station | Circuit | N8LIJ | JUL | 60 |
| Packet | And emergency communications | KAØDXM | OCT | 42 |
| Packet | Internet-to-AX.25 | N1EWO | DEC | 74 |
| Packet | PBBSs | N1EWO | AUG | 62 |
| Packet | Portable stations | N1EWO | OCT | 64 |
| Packet | Station/general information | N1EWO | SEP | 78 |
| Packet on the MAC | Construction | KD6CMT | OCT | 8 |
| QRP Sidetone Companion | Construction | KI5AZ | MAY | 18 |
| RM 7649 | Relayed traffic | WA6ITF | JAN | 74 |
| RTTY | BayCom program | WA3AJR | APR | 78 |
| RTTY | DesqView program | WA3AJR | AUG | 60 |
| RTTY | General description/ equipment | WA3AJR | FEB | 62 |
| RTTY | General information | WA3AJR | SEP | 68 |
| RTTY | General information | WA3AJR | NOV | 78 |
| RTTY | MFJ-1271 TNC | WA3AJR | OCT | 54 |
| RTTY | PK-232/Ameritron QSK-5 | WA3AJR | JUN | 78 |
| RTTY | Software | WA3AJR | OCT | 54 |
| RTTY | Software Sources | WA3AJR | MAR | 76 |
| RTTY | SS-50 | WA3AJR | DEC | 55 |
| RTTY | Using Kantronics Hamsoft | WA3AJR | JUL | 79 |
| Techno-Whizzy 1, Part 1 | DDS radio/construction | N9JZW | DEC | 8 |
| **Direction Finding** | | | | |
| Albuquerque Balloon Fiesta | Description | KØOV | JAN | 48 |
| Antennas | Quads | KØOV | JUL | 54 |
| Antennas | Suggested models | KØOV | JUN | 74 |
| Antennas; hunt how-to | Description; construction | KØOV | MAY | 54 |
| ATV balloon recovery | Southern California, Jan. '92 | KØOV | APR | 66 |
| Controllers | Suggestions | KØOV | JUN | 74 |
| Doppler aray | Phoenix, AZ | KØOV | FEB | 80 |
| Home-brewing | Hints | KØOV | MAR | 70 |
| International | Lvov, Ukraine | KØOV | APR | 66 |
| International | Tips | KØOV | JUL | 54 |
| International | FRG-93 | KØOV | DEC | 72 |
| LARC hunt | Nebraska | KØOV | SEP | 70 |
| Optimum mobile RDF system | KK6CU's RDF system | KØOV | OCT | 46 |
| Optimum mobile RDF system | KK6CU's RDF system | KØOV | NOV | 34 |
| Public service | Helping police | KØOV | JAN | 48 |
| "Sniffing" | Tips | KØOV | JUL | 54 |
| TBOX | Fox controller | KØOV | SEP | 70 |
| Tips | For hiders | KØOV | AUG | 54 |
| **General Interest** | | | | |
| 2m Hazardous to Your Health | Safety tips | N1II | DEC | 28 |
| Amateur radio | Trying something new | N1GPH | NOV | 88 |
| Amateur radio and the First Amendment | Bad language | N1GPH | APR | 98 |
| Antique Wireless Association | General description | WB2MGP | NOV | 64 |
| Colombian Expedition | DXpedition | KC4VLN | FEB | 34 |
| Contests | Suggestions | N1GPH | AUG | 88 |
| CQ All Schools net | From the Pentagon | WB2MGP | OCT | 66 |
| Desert Storm MARS Experience | MARS | NX7T | JAN | 34 |
| DX contacts | Using simple, inexpensive equipment | N1GPH | MAR | 84 |
| Education | Gordon West | WB2MGP | FEB | 46 |
| Education | Home schooling | WB2MGP | MAR | 68 |
| FCC enforcement | Discussion | N1GPH | JUN | 84 |
| Grants | How to get one | WB2MGP | DEC | 78 |
| Hamfests | Running a good one | N1GPH | JAN | 84 |
| Iambic Keyer Paddles | Description of models | N6HI | DEC | 36 |
| Info for beginners | *Radio Fun* | N1GPH | DEC | 96 |
| Invention vs. innovation | Education | WB2MGP | JUL | 80 |
| Moonbase America | Description/education | WB2MGP | JAN | 46 |
| No-Code | Results | N1GPH | MAY | 84 |
| No-Code | Club reactions | N1GPH | SEP | 104 |
| No-Code | Club reactions | N1GPH | OCT | 88 |
| Novice licensing | VEC program | N1GPH | JUL | 88 |
| Packet | And emergency communications | KAØDXM | OCT | 42 |
| Peter I and Bouvet Islands | DXpedition | AJØN/LA8US | MAY | 46 |
| Quarter Century Wireless Association | Description | WB2MGP | JUN | 80 |

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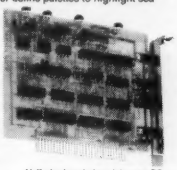

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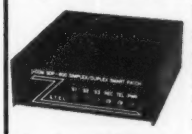

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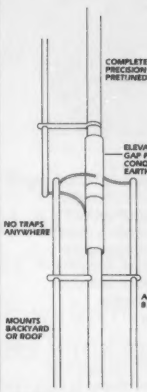


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CIRCLE 50 ON READER SERVICE CARD

| Subject/Article | Description | Author | Issue | Page |
|---|---|---|---|---|
| QSOs | How-to for a good one | N1GPH | FEB | 84 |
| "Radio Renegades" | Los Angeles | WA6ITF | JAN | 74 |
| Radios and Runners | '91 NYC Marathon | Wb2MGP | APR | 64 |
| RM 7649 | Packet | WA6ITF | JAN | 74 |
| Satellite operation | Information resources | WA5ZIB | MAR | 78 |
| SBE | Certification | WA6ITF | JAN | 74 |
| Space | AMSAT '91 Space Symposium | WA5ZIB | FEB | 53 |
| Teaching the teachers | Education | WB2MGP | SEP | 76 |
| Telephones | Outages | WA6ITF | JAN | 74 |
| Youth Forum | Dayton Hamvention '92 | WB2MGP | AUG | 64 |
| Youth Forum | Miami Hamboree '92 | WB2MGP | MAY | 58 |
| **Microwave** | | | | |
| 30 MHz IF strip | 10 GHz transceivers | WB6IGP | JAN | 76 |
| 10 GHz amplifier | Avantek | WB6IGP | SEP | 80 |
| 10 GHz Gunn oscillator cavity | Construction | WB6IGP | FEB | 66 |
| 10 GHz WBFM transceivers | Description/Solfan-type units | WB6IGP | OCT | 56 |
| LOS communication | Theory/construction | WB6IGP | MAR | 48 |
| PMTs and Lasers | Description/circuit | WB6IGP | JUL | 62 |
| PUFF design program | Computer software | WB6IGP | MAY | 74 |
| PUFF design program | Microwave circuits | WB6IGP | JUN | 64 |
| Resistors and capacitors | General description | WB6IGP | APR | 82 |
| RF filters; coaxial and waveguide systems | General description/ construction | WB6IGP | NOV | 50 |
| Using surplus parts | Tips | WB6IGP | AUG | 58 |
| **New Products (by manufacturer)** | | | | |
| AEA | DSP-1232 multimode data controller | Staff | DEC | 69 |
| Amateur Radio Engineering | Silencer Model ARE-10 speaker | Staff | MAY | 66 |
| Antenna Specialists | PRO-5000 mobile antennas | Staff | JAN | 70 |
| Antennas West | Pico-J | Staff | SEP | 44 |
| ARTSCI Publishing | *U.S. Repeater Mapbook* | Staff | JAN | 70 |
| ATV World | ATV transceiver | Staff | DEC | 68 |
| Austin Antenna | Inductor design software | Staff | APR | 70 |
| Baylin Publications | *Wireless Cable and SMATV* | Staff | SEP | 46 |
| Bestway Systems | SCA-1 chassis | Staff | FEB | 60 |
| Brainstorm Engineering | SR4 controller | Staff | JAN | 70 |
| Cable X-Perts | RG Mini 8 (X) | Staff | OCT | 50 |
| Communications Specialists | TS-32P CTCSS encoder-decoder | Staff | FEB | 60 |
| Contact East | Workstation Specialist kit | Staff | SEP | 46 |
| Connect Systems | CD-1 decoder | Staff | SEP | 44 |
| Cushcraft | AP8A antenna | Staff | OCT | 50 |
| Dennis Ditto | Relational Logging System software | Staff | MAR | 50 |
| Daniel A. Fort Productions | Field Day video | Staff | APR | 70 |
| Eavesdropping Detection Equipment | Caller ID | Staff | JAN | 70 |
| Electron Processing | BRI-2 personal repeater interface | Staff | APR | 72 |
| Electron Processing | BRI-2-DUAL/BRI-2-RB | Staff | SEP | 44 |
| Electron Processing | SGR-1 attenuator box | Staff | MAR | 50 |
| Electronic Equipment Bank | 1992 catalog | Staff | JAN | 70 |
| Electronic Equipment Bank | Lowe receivers | Staff | JUL | 74 |
| Enterprise Radio Applications | MK2 Microreader | Staff | DEC | 68 |
| EUR-AM Electronics | Adjustable antenna mount | Staff | NOV | 38 |
| GAP Antenna | Voyager DX-IV antenna | Staff | MAR | 50 |
| Hamtronics | DVR-1 digital voice recorder | Staff | OCT | 50 |
| Hamtronics | Jan. 1992 catalog | Staff | FEB | 60 |
| Hamtronics | Repeater kits | Staff | JUN | 52 |
| Hamtronics | TD-4 selective calling module | Staff | NOV | 38 |
| Handie-Base | HT stand | Staff | OCT | 50 |
| Hart Publishing | *Amateur Radio Mail Order Catalog and Resource Directory* | Staff | AUG | 72 |
| IC Engineering | DIGI-FIELD meter | Staff | DEC | 68 |
| ICOM | IC-728 transceiver | Staff | AUG | 72 |
| IIX Equipment | SO-4 tower bracket; TT-3 tripod; CA-1 coax standoff | Staff | APR | 72 |
| Interflex Systems | KaGOLD DualPort; PkGOLD Enhanced | Staff | NOV | 38 |
| Interconnect Specialists | DTMF microphones | Staff | AUG | 72 |
| International Radio and Computer | QSYer keypad | Staff | APR | 70 |
| ITC Instruments | SA1000 spectrum analyzer | Staff | JUL | 74 |
| j•Com | Model SDP-600 autopatch | Staff | NOV | 38 |
| j•Com | Stealth Antenna | Staff | MAY | 66 |
| j•Com | Ventriloquist voice keyer | Staff | FEB | 60 |
| Japan Radio | JRL-200F HF linear amplifier | Staff | SEP | 44 |
| Larsen | KG 2/70 dual-band antenna | Staff | FEB | 60 |
| Link Plus | MULE signal processing unit | Staff | JUL | 74 |
| Marine Electronics | SUPERLINK software | Staff | JAN | 70 |
| MFJ | MFJ-346 frequency counter | Staff | APR | 70 |
| MFJ | MFJ-1116 deluxe DC power outlet | Staff | OCT | 51 |
| Microcraft Corporation | Personal Code Explorer | Staff | OCT | 51 |
| Midwest Wood Products | Clock | Staff | NOV | 38 |
| Mouser Electonics | Purchasing manual | Staff | MAY | 66 |
| M. M. Newman | Antex TCSU-1 soldering station | Staff | FEB | 60 |
| NCG | CX-224 triband mobile antenna | Staff | MAY | 66 |
| Novatech Instruments | DDS-3 DDS synthesizer kit | Staff | DEC | 69 |
| Nye Engineering | FS73 digital field-strength meter | Staff | SEP | 44 |
| Oak Bay Technologies | PS-101 power strip | Staff | FEB | 60 |
| Overview Systems | AMFAX-10 AM-to-FM converter | Staff | JUN | 52 |
| PacComm | BayMod-9; PacTOR | Staff | OCT | 51 |
| P.C. Electronics | TC70-10 70cm ATV transceiver | Staff | JUN | 52 |
| Periphex | Batteries | Staff | JUL | 74 |
| Personal Database Applications | LOGic, Version 2.1 | Staff | JAN | 70 |
| Planned Products | Micro Circuit Works Conductive Pen | Staff | JUL | 74 |
| Polyphaser | 1992/1993 catalog | Staff | JUL | 74 |
| Pro•Am/Valor | D270 duplexer | Staff | DEC | 69 |
| Procomm/Brainstorm Engineering | FC-1300 frequency counter | Staff | MAR | 50 |
| QSL Post Office | QSL bureau | Staff | MAR | 50 |
| Rabun Labs | ILD/P lightning detection system | Staff | SEP | 44 |
| Sanelli Technology | OSC-100 code practice oscillator | Staff | JUN | 52 |
| Sensible Solutions | WB2OPA LogMaster, Version 4 | Staff | JAN | 70 |
| SGC Inc. | SG-2000 HF SSB transceiver | Staff | JUL | 74 |
| SIGN ON | Removable callsigns | Staff | JUN | 52 |
| *Spread Spectrum Scene* | Newsletter | Staff | AUG | 72 |
| Startek International | Pocket Counters | Staff | APR | 70 |
| Telex Hy-Gain | High-power baluns | Staff | APR | 72 |
| Tigertronics | Model BP-1 packet modem | Staff | AUG | 72 |
| Tripp Lite | ISOBAR Ultra surge suppressor | Staff | NOV | 38 |
| Trionics | Portable power station | Staff | JUN | 52 |
| W & W Associates | Kenwood replacement batteries | Staff | APR | 72 |
| Gordon West | Ham Class video | Staff | MAR | 50 |
| World View Time | Time indicator chart | Staff | MAR | 50 |
| **Power Supplies** | | | | |
| De-rippler to eliminate hum in older equipment | Circuit | N4TMI | SEP | 74 |
| Inverting Power Supply | Circuit | AD5X | JUL | 60 |
| The Lappack | Portable power supply for laptops | W5VBO | MAR | 52 |
| NiCd Restorer/Charger | Construction | N7APE | SEP | 24 |
| Power supply load fixture | Circuit | KB4ZGC | APR | 77 |
| Solid-state emergency backup supply | Circuit | KE5V | SEP | 74 |
| **Receivers** | | | | |
| 10 MHz receiver | Construction | WB8VGE | JUL | 78 |
| Adaptable monophonic output | Circuit | WA5RON | SEP | 74 |
| The Explorer | Construction | K5WMS | AUG | 30 |
| General description | Theory | KB1UM | FEB | 48 |
| General description | Theory | KB1UM | MAR | 66 |
| General description | Theory | KB1UM | APR | 86 |
| Timer controller to prevent NiCd overcharging | Circuit | W5PGG | OCT | 60 |
| **Reviews (by manufacturer)** | | | | |
| Ace Communications | AR3000 communications receiver | N3BAH | APR | 58 |
| AEA | IsoLoop 10-30 | N1EWO | OCT | 16 |
| AEA | Weather FAX decoder | N7IDB | AUG | 42 |
| ANLI | AL800 HT antenna | N1GPH | FEB | 20 |
| Cellular Security Group | MAX System 5-element quad | WB6NOA | SEP | 41 |
| Daiwa | DP-830 digital SWR and power meter | WB8RRT | OCT | 26 |
| Daiwa | PS-304 regulated power supply | N1GPH | MAY | 42 |
| DigiMax | D-1200 frequency counter | KA1MDA | MAR | 18 |
| ELNEC | Version 2.2 | WA4BLC | JUN | 48 |
| The Forbes Group | Ventenna antenna | N1GPH | JAN | 32 |
| Foresight Products, Inc. | "Super Guy" tower guy | W3BMW | SEP | 58 |
| Heights Tower Systems | Aluminum tower | W8CM | JUN | 42 |
| Heil Sound | HM-10 dual & BM-10 boomset mikes | N1GPH | APR | 28 |
| ICOM | IC-728 HF transceiver | WA4BLC | DEC | 22 |
| j•Com | Ventriloquist | WB8ELK | JUN | 40 |
| Japan Radio Co. | JRL-2000F HF MOSFET linear amplifier | WA4BLC | NOV | 26 |
| JPS Communications | NF-60 DSP notch filter | WA4BLC | MAR | 36 |
| Kantronics | KPC-3 packet communicator | WB9EGA | OCT | 30 |
| Larsen Antennas | KG 2/70 glass-mounted | N1GPH | AUG | 46 |
| MFJ | MFJ-247 antenna analyzer | WA4BLC | MAY | 25 |
| MFJ | MFJ-9020 20m CW tansceiver & CW station | WB8VGE | JUL | 36 |
| NCG | Comet CX-224 triband mobile antenna | WB6IGP | SEP | 26 |
| Nye Engineering | FS 73 Signal Cube digital field strength meter | WB9RRT | NOV | 42 |
| Number One Systems Ltd. | EASY-PC PCB layout program | WB6P | APR | 48 |

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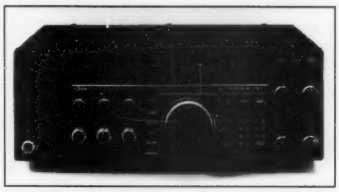

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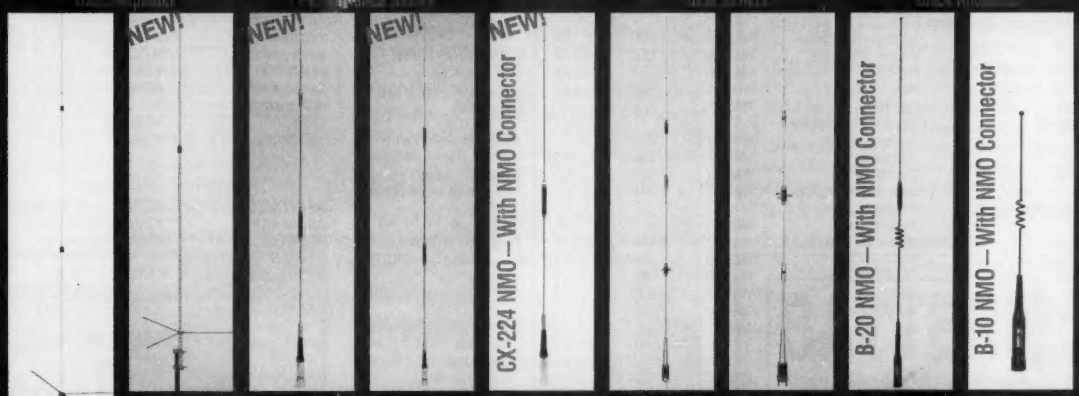


CA-2x4MAX
Gain & Wave:
146MHz 8.5dB
5/8 wave x 3
446MHz 11.9dB
5/8 wave x 8
Max Power: 200 watts
Length: 17' 8"
Connector:
UHF (SO-239)

CA-2x4WX
Gain & Wave:
146MHz 6.5dB
5/8 wave x 2
446 MHz 9.0dB
5/8 wave x 5
Max Power: 200 watts
Length: 10' 2"
Connector:
UHF (SO-239)

FL-62S
Gain & Wave:
146MHz 3.5dB
1/2 wave
446MHz 6.0dB
5/8 wave x 2
Max Power: 150 watts
Length: 3' 5"
Connector:
UHF (PL-259)

FL-67S
Gain & Wave:
146MHz 4.5dB
5/8 wave
446MHz 7.2dB
5/8 wave x 3
Max Power: 150 watts
Length: 4' 11"
Connector:
UHF (PL-259)

CX-224
Gain & Wave:
146MHz 2.15dB
1/2 wave
222MHz 3.6dB
5/8 wave
446MHz 6.0dB
5/8 wave x 2
Max Power: 100 watts
Length: 3'
Connector:
UHF (PL-259) OR
NMO (CX-224NMO)

CA-2x4MB
Gain & Wave:
146MHz 4.5dB
7/8 wave
446MHz 7.0dB
5/8 wave x 3
Max Power:
150 watts FM
Length: 4' 10"
Connector:
UHF (PL-259)

CA-2x4SR
Gain & Wave:
146MHz 3.8dB
5/8 wave
446MHz 6.2dB
5/8 wave x 2
Max Power:
150 watts FM
Length: 3' 4"
Connector:
UHF (PL-259)

B-20
Gain & Wave:
146MHz 2.15dB
1/2 wave
446MHz 5dB
5/8 wave x 2
Max Power: 50 watts
Length: 30"
Connector:
UHF (PL-259), OR
NMO (B-20 NMO)

B-10
Gain & Wave:
146MHz 0dB
1/4 wave
446MHz 2.15dB
1/2 wave
Max Power: 50 watts
Length: 12"
Connector:
UHF (PL-259), OR
NMO (B-10 NMO)

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CIRCLE 54 ON READER SERVICE CARD

| Subject/Article | Description | Author | Issue | Page |
|---|---|---|---|---|
| Personal Database Applications | LOGic Jr. & LOGic II Vers. 2.1 | WA2USG | MAY | 38 |
| Pro•Am/Valor | Micro-Mag Mobile Antenna | AH2AR/8 | DEC | 26 |
| Radio Shack | HTX-202 transceiver | WB6NOA | FEB | 28 |
| Standard Amateur Radio Products | C168A handheld | WB6NOA | JAN | 24 |
| TAB Books | RF circuit design | N3GDE | JAN | 23 |
| Tigertronics | BP-1 packet modem | WB8ELK | DEC | 52 |
| Vector Control Systems | VBI-360 beam indicator | WA3USG | FEB | 15 |
| Yaesu | FT-26 2m walkie | KB1UM | MAY | 50 |
| Yaesu | FT-415 Handheld | KB1UM | JUL | 46 |
| **Reviews (by product)** | | | | |
| Antenna | AEA IsoLoop 10-30 | N1EWO | OCT | 16 |
| Antenna | Ventenna; The Forbes Group | N1GPH | JAN | 32 |
| Antenna, 5-element quad | Cellular Security Group MAX System | WB6NOA | SEP | 41 |
| Antenna, glass-mounted | Larsen KG 2/70 | N1GPH | AUG | 46 |
| Antenna, HT | ANLI AL800 | N1GPH | FEB | 20 |
| Antenna, mobile | Pro•Am/Valor Micro-Mag | AH2AR/8 | DEC | 26 |
| Antenna, triband mobile | NCG Comet CX-224 | WB6IGP | SEP | 26 |
| Antenna analyzer | MFJ-247 | WA4BLC | MAY | 25 |
| Antenna modeling software | ELNEC Version 2.2 | WA4BLC | JUN | 48 |
| Antenna tower | Heights Tower Systems aluminum tower | W8CM | JUN | 42 |
| Beam indicator | Vector Control VBI-360 | WA3USG | FEB | 15 |
| Book review | RF circuit design | N3GDE | JAN | 23 |
| Communications receiver | Ace AR3000 | N3BAH | APR | 58 |
| Digital field strength meter | Nye Engineering FS 73 Signal Cube | WB9RRT | NOV | 42 |
| Digital SWR and power meter | Daiwa DP-830 | WB9RRT | OCT | 26 |
| Frequency counter | DigiMax D-1200 | KA1MDA | MAR | 18 |
| Handheld | Standard C168A | WB6NOA | JAN | 24 |
| Handheld | Yaesu FT-415 | KB1UM | JUL | 46 |
| Linear amplifier | Japan Radio JRL-2000F | WA4BLC | NOV | 26 |
| Microphones | Heil HM-10 & BM-10 | N1GPH | APR | 28 |
| Notch filter | JPS NF-60 DSP | WA4BLC | MAR | 36 |
| Packet communicator | Kantronics KPC-3 | WB9EGA | OCT | 30 |
| Packet modem | Tigertronics BP-1 | WB8ELK | DEC | 52 |
| PCB layout program | Number One Systems EASY-PC | WB6P | APR | 48 |
| Power supply, regulated | Daiwa PS-304 | N1GPH | MAY | 42 |
| Software, Logging | LOGic Jr. & LOGic II Vers. 2.1 | WA3USG | MAY@38 | |
| Tower guy | Foresight Products "Super Guy" | W3BMW | SEP | 58 |
| Transceiver, 2m FM | Radio Shack HTX-202 | WB6NOA | FEB | 28 |
| Transceiver & CW station, 20m CW | MFJ-9020 | WB8VGE | JUL | 36 |
| Transceiver, HF | ICOM IC-728 | WA4BLC | DEC | 22 |
| Voice storage system | µCom Ventriloquist | WB8ELK | JUN | 40 |
| Walkie, 2m | Yaesu FT-26 | KB1UM | MAY | 50 |
| Weather FAX | AEA-FAX decoder | N7IDB | AUG | 42 |
| **Satellite Operation, EME, Space** | | | | |
| AMSAT | '91 Space Symposium | WA5ZIB | FEB | 53 |
| AMSAT | '92 Annual Meeting | WA5ZIB | DEC | 70 |
| AMSAT | A-O-13 | WA5ZIB | SEP | 72 |
| AMSAT | Nets | WA5ZIB | MAY | 77 |
| Antennas | Portable | WA5ZIB | AUG | 66 |
| ATV balloons | Comparison to satellite communication | WA5ZIB | JUN | 46 |
| KITSAT | Description | WA5ZIB | JUL | 53 |
| KITSAT-A | Description | WA5ZIB | NOV | 56 |
| Moonbase America | Description/Education | WB2MGP | JAN | 46 |
| OSCAR-21 (RUDAK-2) | Description | WA5ZIB | OCT | 52 |
| SAREX | 1992 missions | WA5ZIB | MAY | 77 |
| Satellite operation | Information resources | WA5ZIB | MAR | 78 |
| Satellite software | PB.EXE | WA5ZIB | APR | 76 |
| STS-45 | SAREX activity | WA5ZIB | JUN | 46 |
| STS-45 | Update | WA5ZIB | APR | 76 |
| U-O-14/U-O-22 | Activity switch | WA5ZIB | APR | 76 |
| Using RS-12 | Tips | G3IOR | MAR | 32 |
| **Test Equipment** | | | | |
| AC Line Voltage Monitor | Circuit | KB4ZGC | OCT | 60 |
| Battery Watchdog | Construction | WBØTCZ/7 | MAY | 26 |
| Bidirectional power meter | Construction | WB8VGE | OCT | 69 |
| Calibrated Signal Generator | Construction | N2DCH | JUL | 26 |
| Crystal matching and activity tester | Circuit | KB4ZGC | MAY | 64 |
| Crystal oscillator | Circuit | KB4ZGC | JUL | 60 |
| Crystal Signal Source | Construction | KA1MJP | MAR | 14 |
| Crystal Tester | Construction | KA4J | JAN | 22 |
| Dynamic Component Analyzer | Construction | KA1MDA | MAY | 8 |
| Expanded-Scale Voltmeter | Modification | KJ4W | DEC | 60 |
| Field-Strength & Source Dip Meter | Construction | WBØESV | JAN | 8 |
| Frequency Counter Upgrade | Construction | KD9ZT | AUG | 48 |
| Function Generator | Construction | KB4ZGC | JAN | 28 |
| Linear Inductance Meter | Construction | W8VWX | JAN | 38 |
| Measuring RF power | Circuit | KB4ZGC | MAR | 64 |
| NE-602 RF Signal Generator | Construction | Kerr | FEB | 22 |
| NiCd Restorer/Charger | Construction | N7APE | SEP | 24 |
| Power Breaker | Safety advice | WA1FHB | JAN | 18 |
| Protected AC Outlet | Construction | N4TMI | JUL | 50 |
| Remote Field-Strength Meter | Construction | W2IMB | MAR | 44 |
| Voltmeter, LED expanded | QRP operation | WB8VGE | MAY | 62 |
| **Theory, Tips, Tutorials, How-To** | | | | |
| 2m Hazardous to Your Health? | Safety tips | N1II | DEC | 28 |
| Amplifiers | Gain | KB1UM | JAN | 50 |
| Brain twisters | Tips | KB1UM | MAY | 68 |
| Bruene circuit | Measuring RF power | WB8VGE | SEP | 84 |
| Choosing a rig | Tips | KB1UM | SEP | 64 |
| Digital technology | General description/theory | KB1UM | JUN | 70 |
| Digital technology | General description/theory | KB1UM | JUL | 70 |
| Direction finding | Tips for hiders | KØOV | AUG | 54 |
| Filters | For 2m | WB6IGP | DEC | 76 |
| Ham radio acronyms | Definitions | KB1UM | AUG | 70 |
| MAR-x ICs | Description | K4IPV | DEC | 50 |
| Microprocessors | General description/theory | KB1UM | NOV | 60 |
| Microprocessors | General description/theory | KB1UM | DEC | 84 |
| Microwave | Using surplus parts | WB6IGP | AUG | 58 |
| Parts sources | Tips | WB8VGE | JAN | 62 |
| Power breaker | Safety advice | WA1FHB | JAN | 18 |
| QRP | Theory | WB8VGE | AUG | 56 |
| QRP tinkering | Tips | WB8VGE | FEB | 70 |
| Receivers | General description/theory | KB1UM | FEB | 48 |
| Receivers | General description/theory | KB1UM | MAR | 66 |
| Receivers | General description/theory | KB1UM | APR | 86 |
| Satellite operation | Information resources | WA5ZIB | MAR | 78 |
| Spread Spectrum Primer | General description/theory | KC6YJY | NOV | 29 |
| Use Those Surplus Meters | Tips, how-to | KB4ZGC | JAN | 42 |
| Using RS-12 | Satellites | G3IOR | MAR | 32 |
| **Transceivers** | | | | |
| 10 GHz WBFM transceivers | Description/Solfan-type units | WB6IGP | OCT | 56 |
| 20m transceiver | Construction | WB6NKJ | JUN | 26 |
| Argonaut II | QRP operation | WB8VGE | NOV | 66 |
| Ramsey FX-146 | Construction/add 8,000 channels | KG7BK | JUN | 10 |
| Receive Converter Adapter for 2m SAM1 Transverter | Construction | WD4PLI | APR | 36 |
| Ten-Tec Argonaut II | QRP transceiver | WB8VGE | MAR | 74 |
| Transceivers | Construction | W3RW | JUL | 32 |
| Unlocking the HTX-100 | Modification | AC3L | DEC | 20 |
| **Transmitters** | | | | |
| 10m DSB Transmitter | Construction | WA4ADG | JUL | 18 |
| 40/80 Meter Wave Ryder | QRP transmitter/ construction | KI5AZ | MAR | 40 |
| ATV transmitter, Part I | Construction | KA2CWL/K2MQJ | AUG | 22 |
| ATV Transmitter, Part II | Construction | KA2CWL/K2MQJ | SEP | 50 |
| Digital ALC | For transmitters/ construction | N7APE | AUG | 36 |
| QRP 80/40 CW Sender | Construction | G2BZQ | NOV | 8 |
| QRP transmitter | Construction | WB8VGE | APR | 80 |
| Rock Bender QRP Transmitter | Construction | WI5W | APR | 22 |
| Ryan exciter | QRP operation/ construction | WB8VGE | JUN | 62 |
| Techno-Whizzy 1, Part 1 | DDS/construction | N9JZW | DEC | 8 |
| **Updates** | | | | |
| 8,00 Chanels for the Ramsey FX-146 | JUN '92 issue | KG7BK | JUL | 58 |
| Ask Kaboom | JUN '92 issue | KB1UM | JUL | 58 |
| Cheap and Simple Power Supply | DEC '91 issue | WA9VLK/GØNBZ | FEB | 75 |
| Computerized Tuning for Ramsey Receiver Kits | DEC '91 issue | N8KDD | FEB | 75 |
| Crystal Matching and Activity Tester ("Circuits") | MAY '92 issue | KB4ZGC | JUN | 60 |
| Dual-Combo FSM and Source Dip Meter | JAN '92 issue | WBØESV | FEB | 75 |
| DXpedition to Peter I and Bouvet Islands | MAY '92 issue | AJØN/LA8US | JUN | 60 |
| Function Generator; Surplus Meters | JAN '92 issue | KB4ZGC | MAR | 64 |
| GaAsFET Preamp Sequencer | MAR '92 issue | WZ1V | APR | 75 |
| Microprocessor Repeater Controller | OCT '91 issue | WB3ESS | JAN | 58 |
| Packet on the Mac | OCT '92 issue | KD6CMT | NOV | 54 |
| Packet on the Mac | OCT '92 issue | KD6CMT | DEC | 90 |
| Project INSPIRE | DEC '91 issue | KG6EK | FEB | 75 |
| Pseudo CW Filter | JUN '91 issue | W6ZZB | MAR | 64 |
| Rock Bender QRP Transmitter | APR '92 issue | WI5W | JUN | 60 |
| Quag-V | DEC '91 issue | WB3AYW | FEB | 75 |
| Quag-V | DEC '91 issue | WB3AYW | MAR | 64 |
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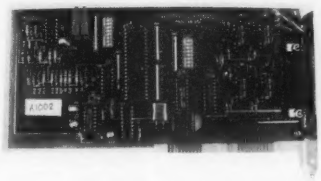

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# NEW PRODUCTS

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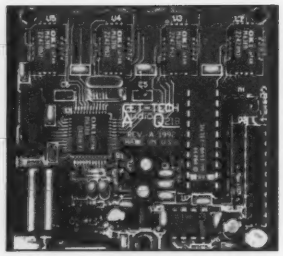

## GET-TECH

GET-TECH has released its digital voice recorder, AUDIO Q218. This unit will record up to 218 seconds of speech. With four selectable sample rates, up to eight different variable-length messages may be stored. Two separately adjustable audio outputs are provided. One high-level output will drive a speaker to 400 mW; the other may be used for output to an external amplifier or transmitter. An on-board regulator allows use from 8 to 15 VDC. Also included is an open collector output for keying a transmitter or external device during playback. The 2.5" x 2.5" unit comes fully assembled and tested, including battery backup and 4 meg RAM.

The AUDIO Q-218 is priced at $149, plus S & H. For more information, contact *GET-TECH, 201 Riley Road, New Windsor NY 12553; (914) 564-5347.* Or circle Reader Service No. 203.

## HAMTRONICS

Hamtronics, Inc. has published their new "January 1993" catalog, which contains 40 pages of kits and wired units for amateur radio, two-way shops, scientific and industrial radio users, and OEMs. It features two new products: a digital voice recorder and a low-cost DTMF controller. The DVR-1 digital voice recorder may be used as a voice ID for repeaters, contest CQ caller, or radio scratchpad. It records up to 20 seconds of real voice audio in one or multiple message segments and plays back through a repeater or small speaker.

The TD-4 DTMF controller provides one latching output based on four-digit commands to turn any circuit on and off. It was designed especially for use as a selective calling unit to be used with any receiver or transceiver to allow the speaker to be muted until someone wanting to call you sends the appropriate DTMF command to open the speaker

These new products are added to the selection of VHF and UHF FM transmitters, receivers, power amplifiers, converters, preamps, repeaters, DTMF controllers, autopatches and digital radio modems which Hamtronics has manufactured for over 30 years. To receive a copy of this new catalog, contact *Hamtronics, Inc., 65-F Moul Road, Hilton NY 14468-9535; (716) 392-9430, Fax: (716) 392-9420.* For foreign mail, please send $2 to defray postage.

## PAKTEK INC.

PAKTEK Inc. is now offering the TOOLPAKS product line. The TOOLPAK original is a backpack tool organizer that secures over 100 of your most needed and important tools; the FANNYPAK is a convenient way to carry those few tools you just can't be without. Perfect for Field Day or remote locations, TOOLPAKs eliminate chasing down tools, keeping those days in the field fun and exciting. FANNYPAK has room enough for your portable and all the extra batteries, leaving both of your hands free. Made of durable abrasion- and puncture-resistant Cordura, the TOOLPAKS haul like a pack and open like a zippered file cabinet, keeping you organized and helping you work more efficiently.

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## GRE AMERICA

GRE America has introduced GINA, Global Integrated Network Access, a wireless data transceiver that transmits and receives data at rates up to 128K baud. GINA eliminates the expense, hassles and restrictions of wire connections, while providing reliable data communications. It utilizes spread spectrum technology, which is highly immune to interference. GINA can be incorporated into a wide variety of applications, including automation, data acquisition and control, security systems and wireless network systems, plus other industries where remote or point-to-point data transmission is necessary. Because GINA utilizes spread spectrum technology, information can be sent transparently, penetrating walls, floors, ceilings and concrete, while still maintaining clear data transmission.

For the price and more information, contact *GRE America, Inc., 425 Harbor Blvd., Belmont CA 94002; (415) 591-1400, Fax: (415) 591-2001.* Or circle Reader Service No. 202.

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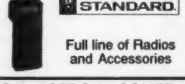


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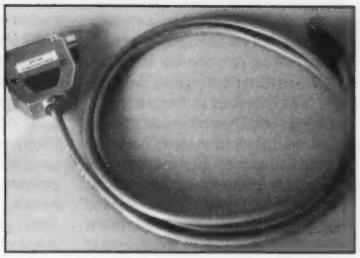


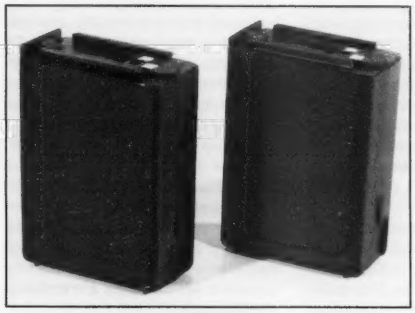
j•COM has introduced a line of transceiver control computer interface cables designed to interface personal computers with all receivers and transceivers which have the ability to be controlled over a serial TTL link. The j•COM interface cable requires no external power supply. The unit requires only 3.5 mA of total power for ICOM and Yaesu models, and 6 mA for Kenwood. Removing the external power supply and its associated cables significantly reduces the susceptibility of the interface to RFI from the transmitter. Emitted RF noise is also reduced. The entire interface has been sandwiched into the shielded hood of a DB-25 connector compatible with the serial interface of most PC compatible computers. j•COM also supplies an optional DB-9 to DB-25 adapter for use with computers using the smaller size "AT" connector. Because the interface is a direct replacement for the manufacturer's own units, it is fully compatible with all rig control software.

The four models of interface cable come completely assembled and ready to plug in. All four are priced at $54.95, plus $5 S & H. j•COM provides a 30-day money-back guarantee and a 90-day parts and labor warranty. Contact *j•COM, Box 194, Ben Lomond CA 95005; (408) 335-9120, Fax: (408) 335-9121.* Or circle Reader Service No. 205.

## A.S.A.

A.S.A. has introduced a product ideal for new hams—an affordable 2 meter colinear base station antenna with unbelievable gain. The model 9209 is made up of four parts and takes approximately 10 minutes to assemble. The master part is a six-foot vertical fiberglas hand-wound whip covered with heavy black heat-shrink with a 3/8-24 thread ferrell (double 5/8 wave over 1/4 wave). At the top is a three-foot stainless steel whip that is inserted one inch into the top of the whip. At the bottom is a double U-bolt aircraft aluminum bracket that fits up to a 1-1/2" mast with a 3/8-24/SO-239 brass connector for your PL-259. The fourth part consists of three 45-degree aluminum radials, 21" long, attached underneath the bracket with screws. The total height after assembly is 10-1/2 feet.

The model 9209 is priced at $32.43, and will be sent UPS within the continental U.S.A. for $4 S & H. For more information, contact *A.S.A., P.O. Box 3461, Myrtle Beach SC 29578; (800) 722-2681.* Or circle Reader Service No. 204.



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Periphex has announced its longer operating time, high capacity, lower cost batteries for the Alinco DJ-580 hand-held radio. The EBP-22S (12 volts, 800 mAh) offers a 15% increase in operating time at high power, while the EBP-24S (7.2 volts, 1500 mAh offers a 200+% increase in operating time at low power. Both batteries are 3" tall. They are completely compatible with the Alinco EDC-24 and EDC-34 chargers.

The EPB-22S is $65 and the EBP-24S is $62. All battery packs include overcharge and over-temperature protection, short circuit protection, and a one-year warranty. For more information, contact *Periphex, Inc., 115-1B Hurley Road, Oxford CT 06478; (203) 264-3985, (800) 634-8132.* Or circle Reader Service No. 206.


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## NEVER SAY DIE

*Continued from page 4*

the channel is occupied, just as a phone or CW op would, and then wait for a possible response, which would put the relay on hold, we might be able to avoid much of the QRM which blind transmissions could incur. Indeed, if the relay station did get a response it should be programmed to keep track of the activity on the frequency and sense when it has ended so it can send another query, checking for any possible new interference.

On 20m and higher bands it's normal not to hear both ends of a contact, so an automatic relay station should be able to do more than merely check for any received signals. It should be intelligent enough, via its software, to avoid interfering when only one side of a contact can be heard. Perhaps we need to agree on some protocols to help simplify this problem.

At any rate, I'm glad cooler heads prevailed and that another escalating brouhaha may have been avoided. We need peace, not war within our hobby.

### ARRL Caves In

The uproar over the ARRL's proposed ban on automated packet on HF was so furious that the League was forced to back down. Indeed, it got so bad that disgusted packeteers were beginning to talk seriously about forming their own national society. Well, when an organization gets that far out of step with a large block of the membership, something has to give. And give it did.

A hasty meeting of the ARRL digital committee, plus most of the board of directors and the executive committee, was held during the ARRL National Convention in Los Angeles. Faced with insurrection, they had little choice but to reverse the board of director's July decision. The details of a new proposal which will allow automated packet still have to be agreed upon, but it looks as if the board capitulation may have defused a very nasty situation which could have seriously hurt League membership.

Indeed, packet operators aren't soon going to forget what they interpret as an antagonism to packet on the part of the ARRL's digital committee and the board. Hopefully the directors have learned a lesson and will be twice cautious before again trying to stop packet pioneering and network development.

With packet operation being virtually the only contribution amateur radio has made to communications technology in a generation, we need to give our packeteers every bit of help we can. We'd like to see HF packet develop dependable 9600 baud systems. We'd like to see them design circuits which will give perfect copy through interference, static, fading and so on. None of this is going to come easily.

It is unfortunate that we seem to have so many extremists in our hobby. The cries that unattended HF packet stations will be jamming our HF bands with unintentionally triggered transmissions is as ridiculous as the predictions that the no-code license would turn our bands into CB-like disasters. We seem at times to have an inexhaustible supply of reason-challenged loud mouths.

Packeteers, stick to your guns and make those fogies on the ARRL board stop trying to be clogs in the wheels of progress.

### Making Money

A 52-page catalog from Home Automation Labs, 5500 Highlands Parkway, #450A, Smyrna GA 30082-5141, reminded me that I've had a few more surly letters from retired hams mewling about not having enough money. Get off your rocking chairs and get busy. I mentioned recently that $10 bills are just hanging out there, waiting to be plucked. Well, presuming you're not a total washout as a ham, you should have the technical expertise to help people set up security systems in their homes, offices, warehouses and so on. Plus you can help them automate their homes.

A retired chap near my home put up some notices on the local supermarket bulletin boards announcing he was in business repairing VCRs, TVs and hi-fis. His come-on was a free estimate of the cost of repair. My wife immediately loaded up the car with a few VCRs and a CD player which had been waiting for me to have time to set up a workshop and then see about fixing 'em. I guess, after year or so of excuses, she figured there might be a better way. Well, this chap, within days of putting out his shingle, is up to here in stuff to fix. His estimate is free. His prices are fair. Plus he brings good old Yankee thrift to the table, getting needed parts from truly defunct VCRs.

If you want to make money all you have to do is look around and see what people need done. It may be handyman work around their homes, feeding their pets while they're on a trip, or you might, as my wife did, find such a need for baby-sitting that you organize a baby-sitting service, hiring dependable women and scheduling for them.

Unless you're a complete zero you must have developed *some* skills. So where can you market them? You can offer services to smaller companies as a consultant, thereby helping them avoid medical coverage, which often adds around 30% or so to the payroll. Very few companies don't need extra help, it's just that it is so much trouble interviewing people and hiring them that they tend to avoid it. So talk to the boss and find out what problems he has. Then show him how you can help solve his problems for a fraction of what he's losing by letting things go.


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PS Form 3526, January 1991 (See instructions on reverse)

Say, have you got a shirt? Well then you're all set to launch a small ham business of some kind. The shirt is what you'll lose. Every now and then I hear someone sounding off about ham companies getting rich off us hams. When I hear that I know I'm faced with a blowhard fueled by massive ignorance. If you want to sell to hams, figure you're doing it as a hobby and make sure you've got a steady outside job to cover your losses.

I almost got into the ham business back in 1946. I'd designed a fantastic little 2 meter transmitter . . . a pair of miniature tubes with a long lines tank circuit and grid modulation. It worked like a charm, even in the trunk of my car. Bill French W2NYC and I talked with Millen rep John de Blasi about their making it. Millen wasn't interested. I was just out of the Navy after WWII and was going back to college in a few weeks, so we decided it wasn't a good time to start manufacturing rigs. In retrospect, perhaps we should have so we could have shared in the catastrophe that hit the ham industry in 1964 when it was almost totally destroyed by the League. Even the mightiest fell . . . including Millen, National, Hallicrafters, Hammarlund and so on. There were no survivors of any size.

On the other hand, going back to college turned out to be a miserable waste of my time. Two years blown to hell, with nothing really to show for it, and very little of any value learned. I sure wish there had been someone around to put things into perspective for me.

Well, back to making money. Most of the businessmen I talk with have plenty of jobs open, they just don't know how to find the people they need. I had lunch with a chap who's working on solid prototyping computers. If you're not aware that there are now printers which will make solid objects you haven't been doing your homework. And if you're not keeping up with what's going on in technology, how valuable are you as an employee?

Desktop manufacturing is going to be a whale of a business in a few years, so this is the time to work with a small firm experimenting with prototypes and come up to speed. In a year you should be able to name your price if you get busy and become an expert.

This new field needs a publication to help it grow, but I'm too short of people right now to tackle it.

So tell me again how you're short of money. Tell me about being out of work. Tell me about not being able to afford that new rig.

### Starting Education From Scratch

For starters we know our present educational system is failing us. Worse, we know that unless we make some major changes we're going to be sentencing our children and grandchildren to a second-class quality of life. Either we turn out the educated and skilled workers needed to do high-tech manufacturing or we're going to continue to see our standard of living sliding.

Having done a hellacious amount of research on the situation, my next priority is to put everything I've learned together into one big report. Then I have to see how I can get the changes started.

Since I'm solution-oriented, my report will tend to emphasize proposed changes rather than just citing what's gone wrong. Unless you've been living the life of a mushroom you're well acquainted with how bad things are. And you probably have read, heard or seen on TV reports on how poorly we're educating our children.

My approach to the educational process is to break it down into child development periods. I'm arbitrarily dividing education into eight age groups. I think you'll see the sense of this as we progress. I think you'll agree that we all tend to learn things differently at different ages. We can't deal with a one-year-old kid the same as we do an adolescent. And ditto someone in their twenties vs. someone in their sixties.

### Age #1

You're probably expecting me to start with kindergarten. No way. By the time kids are five years old around 80% or so of their life's patterns are already fairly firmly set. Nope, we've got to start much earlier. Much, much earlier. Hold your chair and don't laugh . . . we're going to start with conception. I think you'll agree that I'll make a very good case for this. So let's assign Age #1 to the nine months between conception and birth. As you'll see, this is a surprisingly active educational period of life.

As you understand more about the importance of this time, you're going to understand why we need to radically change some motherhood behavior during this critical period of life.

Now, before I can help you understand how education takes place during the prenatal months, I have to go back to some fundamentals of all life. I don't want you to have to take my word for the importance of the prenatal period, I want you to understand why this time is so critical. And from that understanding you'll be able to figure out for yourself what changes mothers need to make.

In my October editorial I explained how all living organisms obey the most fundamental of all laws . . . self-preservation. I explained that all life has a stimulus-response mechanism built in which is designed to warn of possible harm. Trees have this and respond to danger by generating chemicals to ward off invasions of insects or to fight off other plants. In humans pain is our warning medium. Pain tells us when

*Continued on page 82*


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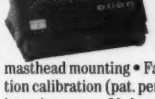

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# QRP

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## Low Power Operation

*Michael Bryce WB8VGE*
*2225 Mayflower NW*
*Massillon OH 44646*

### MOSFETs

For the last year or so I have been playing with a remarkable solid-state device: the power MOSFET (MOSFET is short for Metal Oxide Semiconductor Field Effect Transistor). The power MOSFET was introduced by Siliconix, Inc., in 1976. I find what these devices are capable of doing absolutely amazing. More and more of them are finding their way into my QRP projects.

Figure 1 shows a schematic drawing for a power MOSFET. The three main leads to the power MOSFET are: gate, drain and source. Most power MOSFETs are "N" type devices, but there are several different types being made as "P" type devices. Notice the diode connected between the source and the drain leads. This diode is part of the internal workings of the power MOSFET. The internal diode has the same current ratings as the MOSFET.

There are many, many specifications for the power MOSFET, but we need concern ourselves with only four. First, there is the continuous current for the drain, commonly called I(D). The drain current is for a specific junction temperature and at a specific gate voltage.

The second specification is the gate on resistance, known as RDS(on). This is the resistance the FET shows when it is turned fully on. This resistance is measured between the source and the drain.

Third is the voltage of the MOSFET. As a rule, as you lower the RDS(on) the voltage rating of the MOSFET is also lowered. In other words, a power MOSFET with an RDS(on) of 0.028 ohms may be rated at a voltage of 50 volts. On the other hand, a power MOSFET with an RDS(on) of 0.018 ohms may have a voltage rating of only 30 volts. They make power MOSFETS to handle up to several hundred volts. However, as the voltage increases, so does the RDS(on) resistance. With the higher voltage, you can have an RDS(on) of several ohms.

The RDS(on) resistance is also dependent on the temperature of the MOSFET junction. Most power MOSFETS have a positive temperature cure. As the power MOSFET heats up, the RDS(on) resistance increases. This increases the voltage drop across the device and causes even more heat to be built up.

The fourth specification is input capacitance. The capacitance varies with the die size of the power MOSFET, but it generally ranges from 30 pF to 3,000 pF. This capacitance must be taken into account when designing amplifiers. The extra capacitance will hold the gate on a bit longer while doing high speed switching. A special driver circuit must be used to ensure proper gate turn-off times.

### Using MOSFETs

The power MOSFET makes a perfect high-side switch. Unlike the bipolar transistor with its 0.7-volt drop, a single high-side MOSFET switch can have a resistance of less than 0.010 ohms! You can easily run 30 amps of current through a high-side power MOSFET switch and dissipate only 9 watts. If you run high current like that through a transistor, you'll have a real heat problem on your hands. By adding more power MOSFETs in parallel, you can drop the RDS(on) resistance to extremely low values. I've run 30 amps through several power MOSFETs and have a calculated loss of only 2 watts!

To use a power MOSFET as a high-side switch, you will need to build a voltage pump or some other type of gate driver. A voltage higher than the voltage being switched is needed to turn the MOSFET on for high-side switching. In a typical 12-volt system, a gate voltage of +20 volts will be required. Most MOSFETs have a limit as to the maximum voltage applied to the gate. This is normally +20 volts maximum. Voltage higher than this may cause the insulator surrounding the gate to be pierced, destroying the MOSFET. This is known as the breakdown voltage.

A voltage pump can be as simple as an oscillator and a voltage multiplier circuit. There are several different types of MOSFET gate drivers available. These are little more than a voltage pump and associated control circuitry, all contained in a single 8-pin DIP IC. Right now, these ICs are somewhat expensive and hard to obtain. Figure 2 shows a simple voltage pump. Notice that it consists of a single CMOS IC and some diodes. Two stages of the IC are configured as an oscillator. With the values shown, the oscillator runs at about 300 kHz. When the control line is pulled low, the output of the oscillator is coupled to the two 0.01 capacitors and then into the voltage multiplier. The output is about +22 volts. This voltage pump works up to several kHz. It's a bit slow to turn off and therefore may add some distortion to the output if you try to switch it off and on at a rate of over 20 kHz.

A zener diode on the output of the voltage pump will protect the MOSFET's gate from over-voltage. This is but one version of a voltage pump. I've used just about every configuration with just about every IC known and have always come up with something that works. A 555 timer in a stable mode makes a great voltage pump.

You can parallel-power MOSFETs

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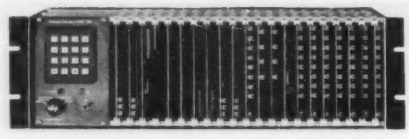

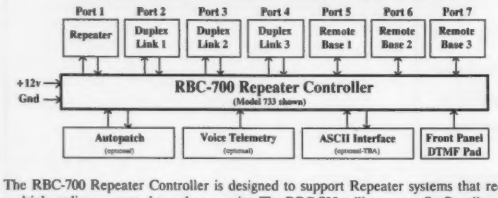


The RBC-700 Repeater Controller is designed to support Repeater systems that require multiple radios connected together at a site. The RBC-700 utilizes a true 7 x 7 audio matrix switch which allows several conversations between ports at the same time. In the illustration above the 733 model is supporting a Repeater, 3 Duplexed Links to different sites, and 3 Remote Bases. Using simple commands, a user could tie the Repeater and a Remote Base to one Link, while the other Links are communicating through your site, holding separate conversations. Or, connect all of the ports together - like a big party line !!

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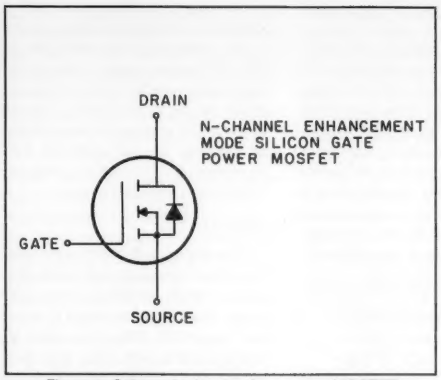


*Figure 1. Schematic drawing for a power MOSFET.*

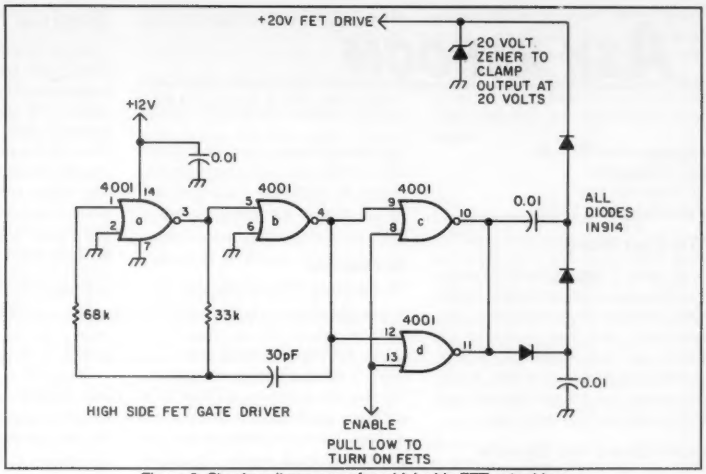


*Figure 2. Simple voltage pump for a high side FET gate driver.*

without too much trouble. You don't need to worry about picking out a "matched pair" as you do with transistors.

In theory, a perfect switch would have zero resistance when on and infinite resistance when off. A power MOSFET comes very close to a perfect switch. And indeed, a power MOSFET makes a very good switch. Power MOSFETs are used in a variety of switching applications, mainly in switching power supplies. The new compact fluorescent lights use high voltage power MOSFETs instead of a magnetic core ballast.

A power MOSFET is a voltage-controlled device unlike the transistor, which is a current-controlled device. The drive requirement for a power MOSFET is easy to obtain. For simple switching circuits, a gate voltage of +10 volts will turn the MOSFET fully on. One of the best traits of the power MOSFET is the ability to be rapidly switched on and off. This makes the power MOSFET a very good candidate for RF switching and amplification. A power MOSFET amplifier can be operated in Class A, AB, B or C. The power MOSFET is particularly immune to high SWR damage.

If all of this is true, then why have we seen so little about the power MOSFET? Well, price is one thing that has kept them from use. However, the price of single-lot power MOSFETs has fallen to the point where you can now buy them for under two dollars. For MOSFETs with a really low RDS(on), the price is still a favorable $4-$5 each.

For use in RF applications, most power MOSFETS like to see a source voltage of +28 volts. While it takes no more effort to build a 28-volt supply than to build a 12-volt one, a 28-volt transceiver is much harder to operate in the field on batteries. When used with a commercial power line, that restriction does not apply. In fact, many of the newer transceivers today use high voltage (+28 volts) power MOSFETs in the power amplifier stages. The higher supply voltage gives them a better efficiency and a cleaner output than a bipolar transistor. Japan Radio has recently placed on the market a 1 kW solid-state amplifier using high voltage power MOSFETs running with a +60-volt supply. The higher voltage also allows the designer to use a smaller power supply. It's much easier to generate +60 volts at 50 amps than +12 volts at 250 amps.

Because the power MOSFET is a high impedance device, it can become unstable when used in certain designs, and God knows, I've fried many a power MOSFET in my workshop. I've blown the tops right off the case, leaving only the leads left soldered to the PC board.

They will oscillate on their own for no apparent reason. Even when used as a switch, the wiring to and from the power MOSFET as well as the layout of the PC board must be taken into account. One designer I know who is working on a high power (2 kW) sine wave inverter told me to add ferrite beads to the gates of each power MOSFET to keep them tame. Lay out your circuit for a power MOSFET just as you would any RF device, even if you're not using the MOSFET in an RF application. This includes good grounding and plenty of bypassing, especially on the gate lead. All leads must be as short as possible. No clip leads are to be used here.

**What's Available?**

Here are some typical power MOSFETs you can buy. The IRF511 is available from Radio Shack. It goes for about $2 and has an RDS(on) of 0.5 ohms at 4 amps of drain current. It's not a real "hot" MOSFET as they go, but you'll find it hanging on the pegs at the local "shack." For a much better device, use an IRF531. This MOSFET is about 10 times better than the 511 and has an RDS(on) of about 0.05 ohms at a drain current of 15 amps. Both the 511 and the 532 come in a standard TO-220 case style.

For even more current and a lower RDS(on), try the IRFZ30 and the IRFZ42. These MOSFETS have a drain current of over 50 amps! The RDS(on) is a scant 0.028 ohms. Although much harder to find, the Siliconix SMP60N06 has a drain current of 50 amps and a RDS(on) of only 0.018 ohms. Siliconix also makes a 30-volt MOSFET with an RDS(on) of 0.010 ohms. That's 10 milliohms of resistance! Again, these devices come in the standard TO-220 case. You can find these MOSFETs listed in both the Digi-Key catalog and the Mouser Electronics catalog. Neither company carries the Siliconix devices.

Because the TO-220 case is electrically hot, when mounting the MOSFET to a heat sink you must insulate the device from the heat sink. You can use any of the TO-220 mounting kits on the market. Radio Shack sells one for under a buck.

I have found that even though the device may be rated at 50 amps of drain current, getting that much current in and out can be a real engineering task. It's better to use two or more MOSFETs in parallel to split up the current instead of using one MOSFET.

Next month I'll have some circuits using power MOSFETs. Also, in the coming months I'll show you how to build a solar charge controller using pulse width modulation by way of power MOSFETs. Stay tuned—there's a lot of good stuff coming up here in the "QRP" column.

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# ASK KABOOM

## The Tech Answer Man

*Michael J. Geier KB1UM*
*c/o 73 Magazine*
*70 Route 202 North*
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### The Last Micro

Hi, folks. I think we're finally ready to wrap up our Micro Power miniseries. We've covered what micros are, how they work and what can go wrong. Let's look at some of the other circuits sometimes used with microprocessors and microcontrollers, and at the problems they can cause.

#### Reach Out and Scan Someone

Some rigs just have too many buttons and switches for one chip to read them all! This can be true even when the switches are multiplexed. In such big radios, input/output (I/O) expander chips are used. These are nothing more than data selectors or multiplexers. In this case, though, the term "multiplex" has a slightly different meaning than it does when applied to switches. What these chips do is place the binary value of some of their input pins onto their output pins, with the computer selecting which input pins are to be examined. For instance, there may be 16 input pins and four output pins. By sending a code to the multiplexer chip, the computer can check all the input pins in groups of four.

Another technique sometimes used is data encoding. Here, the 16 input pins are simply converted into a four-bit word. (Remember, four bits can specify 16 different states.) The computer simply decodes the four bits to determine which button was pressed. The disadvantage of this system is that it can only tell if any *one* button has been pressed. Multiple presses will cause an erroneous code. That is, unless the buttons are scanned first, as I described a couple of columns back.

#### No Response

If the radio won't respond to a button press, there are some clues to look for before you dig in with the scope. First, is it just one button that won't work? If all the others work, I'd suspect the switch itself. Check the voltage on both sides of it. If you see a pulse, then you know it's a multiplexed (scanned) switch. The pulse should appear constant on one side of the switch and come and go on the other side when you press the button. If you can't find the pulse on the other side, the switch is not making contact. In particular, that can happen with flat membrane switches, particularly if they've been exposed to bad environmental conditions such as liquids or prolonged cigarette smoke. If the switch is bad, you may be able to peel it apart and clean it if you're careful.

If you get DC on one side of the switch and nothing on the other side, try scoping the DC side while you press the button. If it goes to zero, the switch is working. If it doesn't, check the other side. If it rises, again, the switch is working. If there's no change, the switch is *not* working.

#### Getting Lost

If the switch is working, the signal must be getting lost somewhere on its journey to the micro. Unfortunately, that journey may be quite convoluted! If the I/O system is scanned, chip by chip, by the micro, the button press may be turned into no more than a tiny blip before entering the bitstream. It can be mighty hard to separate the blip you want from all the other blips because everything is traveling on a common buss, just like in any computer system. Really, it can be next to impossible without a logic analyzer, or at least a dual-trace scope and a lot of luck.

A bad I/O chip is much more likely than a bad micro. Try this: Trace the switch back to the I/O chip. Now find the "chip select" pin. There should be a pulse on it. Trigger your scope on that pulse and then check the output pins, one by one, while you press and let go of the button. If you find an output pin with a pulse appearing or disappearing when you press the switch, the I/O chip is good. If you can't find any change, the chip probably is bad. There's no easy way to be absolutely sure, short of trying a new chip. Luckily, many radios use standard I/O chips you can get from American companies. Some, of course, don't.

By the way, if there is no pulse on the chip select pin, check the schematic to see if that pin is tied high or low. In some simple systems it can be, particularly if there's only one I/O chip to begin with. Most likely, though, there are several chips being scanned. If the chip select pin is connected to the output of another chip, and there's no pulse, suspect the *other* chip, because it isn't driving the I/O chip. Of course, *it* may not be getting the signals it needs. Now you can see why it can be so maddeningly difficult to mess with any but the smallest digital systems. You can spend an awful lot of time going down blind alleys and buying chips you don't need.

> ***"Some rigs just have too many buttons and switches for one chip to read them all!"***

#### Going Out

The same I/O techniques are used for LED annunciators and some other output signals, including those which actually control various parts of the radio. Remember, when you select the operating mode (AM, SSB, etc.), IF filter, etc., you are really telling the micro to select them. It interprets your request and sends all kinds of signals to various circuits in the rig. For instance, when you change bands, not only does the frequency synthesizer get set, but the various bandpass filter relays get set, too. Ever notice that tuning through certain frequencies causes a mechanical click from the radio's interior? That's a bandpass filter relay being tripped.

I/O failures can cause all kinds of strange symptoms. For instance, if transmit output power or receive sensitivity is way down only on a certain band, check that the bandpass filter relay is being set, and that the relay contacts are working. Also, many functions are switched with diodes, and a bad diode can make it look as if the I/O system isn't working properly.

In general, I/O failures are more common on the output side than the input side because many outputs are driving things, such as LEDs, which require substantial current. Some radios use buffer transistors to protect the chips, but many don't, and those can stress the chips to the burnout point.

#### Memories . . .

ROM and RAM can fail. When they

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do, the micro essentially has a case of Alzheimer's disease, and it acts accordingly. It may do strange things, such as write garbage to the display or refuse to tune properly. Usually, though, it'll just crash altogether and become non-responsive.

If the failed memory is inside the micro, the chip must be replaced. If the memory is external, you're in better shape because memory chips usually are a *lot* cheaper than micros. At least, RAMs are. ROMs are another story because they contain the manufacturer's operating program. Although the chip may only be worth five bucks, you may pay $50 or more for a new one. You're paying for the software, not the IC!

Memories can fail in three ways. First, the chip can die completely, with all of its outputs stuck either high or low. This is the most common type of failure, and the stuck outputs can pull down (or up) the entire buss, making it very hard to find the guilty chip without pulling them, one at a time. In the case of soldered-in chips (which most are), the likely damage to the PC board from removing all those chips is so severe that you would be foolish to try it.

Another failure mode causes just one of the chip's output lines to get stuck. That will cause one of the buss's lines to get stuck. If you see activity on all the buss's lines except one, suspect this kind of failure. Try disconnecting from the board the suspect pin of each chip, one by one. Be sure to reconnect them after each try so that only one is disconnected at a time. Of course, the computer won't work properly in that state, but if the stuck buss line starts showing pulses again, you've found the bad chip.

The weirdest failure mode occurs when only one memory cell goes bad. In that state, everything continues to work, but it just doesn't *work*. Data gets scrambled and the computer malfunctions. The problem may be as subtle as a wrong display digit or indicator light, or it may shut the computer down altogether! Trust me, you won't find this problem. If you suspect it, go find the shipping box. Luckily, this kind of failure is pretty rare. I've seen only two memory chips do it.

***"Remember, most thermal problems are caused by bad connections, not bad chips."***

**All Het Up**

These failure modes can be thermal, too. Generally, a chip with all lines stuck is dead and will *not* be thermal. But a single line can be working when the chip is cool and then quit when things warm up. A single bad memory cell can do the same. A can of cooling spray will really help here. By the way, there now are ozone-friendly cooling sprays available. I have a can, and it is odd stuff. It works pretty well, but it is very heavy and it literally "falls" out of the can! It looks quite strange when you spray it. Also, it tends to ruin plastic, so keep it away from the outside of the radio.

If you have a thermal problem, spraying the chip will not directly return the computer to operation the way it would in an analog system. By the time you spray the part, the computer's program is off in never-never land. The cure is to spray the chip and then turn the radio off and back on. If there's a reset button, that should do it, too. Remember, most thermal problems are caused by bad connections, not bad chips. Even if spraying a chip fixes the problem, check the connections to the board before replacing the part. Even if they look OK, try resoldering them. You never know, you just might save the cost of a new IC!

Now, let's look at a letter:

**Dear Kaboom,**

*My TS-940 has an odd problem. It works fine for a while, then it goes nuts! The display gets weird and the rig won't work. If I turn it off and on again, it works for a while, then it does the same thing. Clearing all the memories has the same effect. Any ideas?*

**Signed,**
**Scrambled**

**Dear Scrambled,**

This is very appropriate to our current topic. Your rig's computer is getting trashed. This one's easy, though. If you remove the unit holding the speaker, you'll see a sealed metal box. Unscrew the cover and you'll see the "Digital-A" board. On it, there's one socketed IC, and that's the ROM which contains the rig's operating program. Early '940s often had this problem, and the solution is to pull the IC and put it back in, being sure to press it in all the way. (Be careful not to reverse the chip, of course!) Apparently, the heating and cooling cycle makes the chip work its way out of the socket over a long period of time. (My old Apple II+ had the same problem!) Later '940s had a wire soldered to the ground pin of the IC, and even later ones had no socket at all. I suspect yours is an older one, though, or this wouldn't be happening.

Well, I think that about covers the micros so, next month, we'll get into something new. See you then. 73 de KB1UM.


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## Simulated Circuits—DSP High Tech in Your Shack

As most of you already know, one of the major components of a TNC or multimode controller is a modem. "Modem" is a compound of the beginnings of the words MODulate and DEModulate. It is the modem's job to turn digital signals—which consist of simple "on" or "off" information, unsuitable for transmission on an audio channel—into analog signals which are suited to audio transmission. Normally, the modem does its job with the help of analog filters. These are tuned circuits that react to the presence of the tones used by some particular communications standard. For example, packet radio running at 300 baud on HF uses tones at 2110 Hz and 2310 Hz to transmit data. So, to receive 300 baud HF packet, a modem needs filters at these frequencies. Keep in mind that this is meant to be a simple example to get the point across: As the data rate increases, the complexity of the modulation scheme follows, using other aspects of the signal, like its phase. The example given is called "FSK" for Frequency Shift Keying.

The idea is this: Until recently, if you wanted to receive a particular mode, you needed a modem specific to that mode, made of analog parts and somehow connected to your controller. While you still need a modem designed for each mode's unique properties, it no longer needs to be made of capacitors and resistors. How is this possible? Thanks to a technology—not new, though only recently affordable—called DSP (Digital Signal Processing). DSP is an application of computer technology that lets a hardware engineer design and implement an analog circuit in software. That circuit is a simulation of the discrete (individual analog component) version that functions precisely as if it were a normal analog circuit. This approach brings a number of advantages, with two being of particular interest to the ham.

### Performance

Within their operational limits, digital filters can provide much better performance than analog versions. One of the reasons is the ability to precisely tune the behavior of the particular filter, even to the point of having it change characteristics to best suit the current situation. Digital filters can be created with characteristics unavailable in analog designs—such as the brick wall filter you will find in your CD player. This filter is designed to completely eliminate any output above 20 kHz, and the digital version can have a *very* steep cutoff not possible in an analog implementation.

### Flexibility

This is the part that will be near and dear to the hearts of those of you who have gone from RTTY to AMTOR to 1200 baud packet to 2400 baud packet—you get the idea—buying a new box for each mode. A DSP-based multimode controller just doesn't become obsolete—at least not for a *long* time. Why? Because the modems—those pesky parts that are different for each mode—aren't real, they're simulated by the DSP chip. This means that a DSP-based unit only needs new software to operate in the latest and greatest mode. Finally, you can buy one box and stop.

Of course, modems are not the only use for filters in the hamshack. AF (Audio Frequency) and RF (Radio Frequency) filters that tailor the signal heard from an HF receiver are also vital to good operations, particularly on crowded bands populated with rogue broadcast stations—like 40 meters—or stations whose entire ham radio interest (it seems) is tuning up on top of other QSOs—commonplace on 20 meters. Traditional analog filters *can* help with these problems, but the limitations real world filter circuits place on them makes them far from ideal. For example, a good analog notch filter can eliminate much of a single interfering carrier—like the heterodyne from a broadcast transmitter, or a station tuning up—but they are difficult to tune and can only deal with a single interfering signal at a time. Enter DSP, perfectly suited to this problem. With a relatively simple DSP filter it is possible to adaptively (that is, on-the-fly) notch out interfering signals—automatically!

This is possible because of the *highly correlated* nature of a heterodyne type interfering signal. In other words, the signal is constant and regular—completely unlike the human speech that is carried by the desired signal. A DSP-based notch filter can automatically identify and eliminate multiple interfering carriers with very narrow notch filters, built on-the-fly by the filter box itself—no tuning or adjustment. Imagine being able to have SSB QSOs on 40 meters again, at night! If this sounds like magic, well it is a sort of computer technology magic, but it works. This problem is ideal for DSP because of the nature of the interfering signal—steady and constant. What about problems with interfering impulse (ignition), or white noise, that don't share this convenient obviousness?

DSP can help here, too. The technique is just the inverse. Get this: The DSP filter listens to the signal, identifies the human speech by its characteristic properties (speech is not highly correlated like a carrier, but it does have specific qualities that separate it from noise and other signals), and builds a bandpass filter—again on-the-fly—that fits the speech. The effect is to filter out the surrounding signals that are interfering. The results of this process are not quite as miraculous as the notch filter but it works, dropping the noise by as much as 20 dB. There are some limitations to this technique, and it won't take a signal from the mud and make it louder than the S9+20 noise from the dirty power line insulator down the block. On the other hand, it certainly will reduce the user fatigue caused by listening to the noise surrounding the signal you want, and make QSOs on the HF bands less headache-producing.

***"Within their operational limits, digital filters can provide much better performance than analog versions."***

### What You Can Buy

Thanks to the general availability of low cost DSP chips, several manufacturers now offer DSP-based ham radio gear. These products fall into the two categories discussed above—multimode controllers and adaptive filters. Here's a list (fairly complete, but certainly missing a few) of what you can order today to get on the DSP bandwagon, and maybe reduce some of those heterodyne headaches.

### Multi-Mode Controllers

**DSP-1232 and DSP-2232**
AEA (206) 774-5554
List Price:
DSP-1232 $789
DSP-2232 $999

The DSP-x232 series of data controllers from AEA are available now through dealers. The difference between the two units is in the number of radio ports—one for the 1232 and two for the 2232. The DSP-x232 is based on the Motorola DSP56001 DSP chip, paired with a Zilog Z-180—which does the general purpose computing. The currently-shipping version of the DSP-x232 offers 10 modem programs for the DSP56001 stored in ROM:

300 baud HF packet
1200 baud VHF packet
2400 bps packet
1200 bps BPSK packet (satellite)
HF RTTY
Morse
Facsimile
FM SSTV
9600 bps (K9NG compatible)
1200/4800 bps ASCII (Satellite)

and dual port operation (DSP-2232) for 300/1200 or 1200/1200 baud packet, and RTTY-AMTOR/1200 baud packet combinations. There is 32K of DSP RAM which can be used to download additional modems into the unit. These future modems will be delivered by AEA on diskette, or be made available for downloading from a BBS.

**DSP-12**
L.L. Grace Communications Products
41 Acadia Dr.
Voorhees NJ 08043
(609) 751-1018
List Price: $695
RAM Expansion: $99
A-to-D, D-to-A option: $49

The DSP-12 from L.L. Grace is ideal for the experimenter. Along with its DSP56001 DSP chip, it sports a V40 (PC-compatible) processor on board. This means that programs for the box can be written in readily available PC-based languages with all of their associated development tools. With the 1 megabyte RAM upgrade option, the DSP-12 could be made into a standalone packet station with a sophisticated terminal program built-in, or a special-purpose communications device. Also available for the DSP-12 is an eight-channel A-to-D and DAC option which allows for all sorts of possibilities—including telemetry, voice recording and playback, and any other analog application that the experimenter can think of.

Out of the box, the DSP-12 works as a multimode controller, and provides modems for a variety of modes, including advanced satellite operations, in addition to the standard HF and VHF packet and RTTY modes.

### DSP-based Filters

**NF-60 DSP Notch Filter**
JPS Communications
P.O. Box 97757
Raleigh NC 27624
(800) 533-3819, (919) 790-1048
List Price: $149.95

The NF-60 from JSP is a DSP-based notch filter that automatically

eliminates multiple interfering carriers. The unit is connected between the speaker output of your rig and an external speaker (for which it has a built-in amplifier). It has only two controls: a power switch and a notch switch. When turned on, the unit automatically detects and eliminates steady-state interfering signals. It is very fast at acquiring and eliminating these signals, and is rated at less than six milliseconds.

The unit works very well, and is ideal for regular users of 40 meter SSB.

**NIR-10 Noise/Interference Reduction Filter**
JPS Communications
(see above)
List Price: $349.95

The NIR-10, also from JPS, incorporates the functionality of the NF-60 (above) and adds and adaptive speech filter. The unit works well and significantly reduces background noise when the desired signal is noticeably stronger than the interfering noise. It also incorporates a variable bandpass filter, which is user adjustable.

**DSP-100**
Kenwood U.S.A. Corporation
P.O. Box 22745
2201 E. Dominguez St.
Long Beach CA 90801-5745
List Price: $629.95

The DSP-100 from Kenwood is an accessory item for their TS-850S, TS-690S, and TS-450S HF transceivers. The DSP-100 includes a speech processor based on DSP, and two DSP-based notch filters. These are selectable from front panel switches.

**DSP-59 DSP-based adaptive noise filter**
Timewave Technology, Inc.
2401 Pilot Knob Rd.
St. Paul MN 55120
(612) 452-5939
List Price: $299
(introductory)

The DSP-59 from Timewave is similar to the JSP NIR-10 described above. It provides adaptive speech filtering and sharp filters for CW, RTTY, and SSB. It also incorporates automatic heterodyne elimination. The unit will ship sometime in early December 1992.

As you can see from the list, if you are willing to spend a bit of money, you can get in on the DSP technology revolution. For those of you who cannot spend the money today, hang on. Within a year or two many DSP products will turn up with much lower price tags. If you are a regular HF SSB user, though, DSP adaptive filters make so much sense it's hard to turn them down.

**A Mini-Survey**

I'd like to get an idea of what you are doing out there. If you could take a moment to answer the following questions [respond by paper mail to the address above, or by e-mail to the address(es) below—preferred] it will help me to make this column more useful to you.

1. What is your callsign?
2. What is your license class?
3. What computer(s) do you use in the shack?
4. What operating system/environment version(s) do you use?
5. Which digital modes are you *equipped* for?
6. Which digital modes are you *active* in?
7. Which of these columns (month, year) has been your favorite (if any)?
8. What has been your biggest problem with computers in ham radio?
9. What would *you* like to see in this column?
10. *Any* comments:

You don't need to copy the questions; just put the number before your answer. Answer all the questions, or just the ones you want. Make the responses wordy or brief. I really want your feedback to make this column something you look forward to each month. Thanks so much for your participation.

*My Electronic Addresses:*

Packet: N1EWO@N0ARY
(Note: I'd love to hear from you on packet—but not about the survey! This survey is the business of this magazine, and we can't do that on ham radio. However, a personal note or test message is just fine.)

Internet: jsloman@mcimail.com
(This is my preferred address.)

MCI Mail: jsloman
(This is the same as above, but direct.)

CompuServe: 71221,1143
(This is my least favorite place to get mail, but it is OK.)

Even if you don't answer any survey questions, I am very interested in anything you have to say. I can't answer every message—though e-mail has a *much* better chance. Many of you have written asking for help. You have not been forgotten—I am planning a "mail bag" column for the near future where I can answer the many similar questions that come in. For those of you who have written saying that you enjoy the column, thanks. For those of you who would like to see additions/changes, please write to me—it's the only way I have of knowing what you need and want. 'Til next month, 73 de N1EWO.

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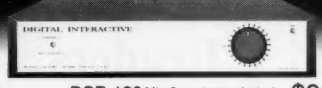


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Terry Gerdes AB5K

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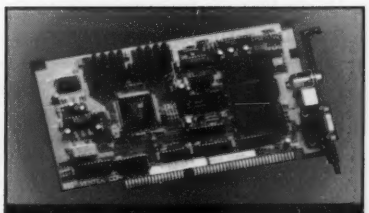

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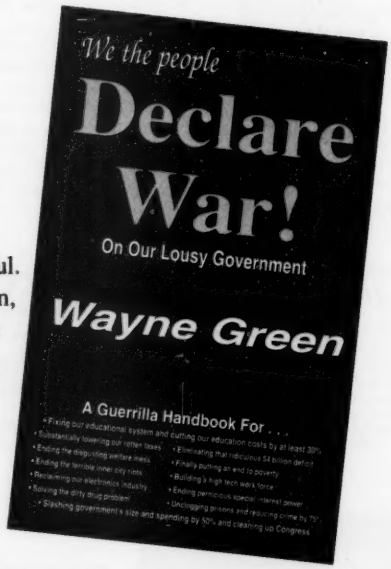


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## The Down East Microwave DEM 432K

*Continued from page 36*

output peaking can be had by adding or removing a turn from L4 and L5. I found in several cases that coils on all boards required at least one-turn modifications either way, but all of these updates are now in the manual.

By connecting your low-level (1 to 3 milliwatt) signal at 28 MHz to the T70, you should be able to measure 40 to 60 milliwatts of energy at 432 MHz with your millivolt/wattmeter. Otherwise, just connect a dummy load or antenna and listen on a 432 MHz receiver for your signal! To verify that the receive converter is working, connect its output to your 28 MHz receiver and use a weak-signal source at 432 MHz. You can also use a handie-talkie several feet away to run this test.

If all has gone smoothly, you've got the basic building blocks of your linear transverter up and running. The next step is to build up the 432PAK amplifier kit. Although you won't need to install the LO/T70/R70 boards in any kind of case yet, you should build the power amplifier right into its chassis before testing it. The PAC-TEC enclosure works perfectly, measuring 4-1/2" long x 2-1/2" wide and 1" deep. Make sure you don't bend the leads more than you have to when soldering the power module to the board.

My approach was to drill and secure the board to the box first, then install the power module (with a bit of silicon grease) to the box with the leads straddling the PC board. (See Photos A & B.) This works very well, offers excellent heatsink capacity and is quite strong. I used 1000 pF feedthroughs to bring bias and operating voltage into the box, while the RF in and out connections are direct-wired with miniature coax.

Once the PA kit is complete, you can test it by applying 13.8 volts to both pins and connecting a wattmeter and dummy load to the output. Connect the T70 board's output to the 432PAK input and apply drive from your 28 MHz source. You should see anything from 12 to 20 watts, depending on drive level. There are no adjustments to make after this.

### Packaging

The three boards were designed by Rick Campbell KK7B to be stacked as close as 1/4" from each other. This is a godsend as a space-saving technique, and you can fit all three into the larger PAC-TEC box (8-7/8" long x 5-7/8" wide x 2" deep) with a half-inch to spare. My suggestion is to mount the R70 board on the bottom, followed by the T70 board and then the local oscillator on top. Now you'll want to think about some kind of T/R switching. Although Down East offers their SHF PINK pin-diode switch kit, I decided to use the extra LO pads and a small Radio Shack relay (275-249) to do the trick. Make sure you connect a spike protection diode backwards across the relay—anything will work; I used a 1N4004 as I had a junk box full of them. Photo B shows the detail of the pad up close, as well as a small preamplifier I added to the box. The preamp comes from Steve Kostro N2CEI and uses an Avantek ATF20135 device to develop about 14 dB gain with a noise figure better than 0.5 dB. Photo C shows the finished unit with the cover off. I used chassis-mount SO-239 connectors for the 28 MHz IN/OUT ports, and BNC connectors for receive and transmit connections at 432 MHz. They're spaced to be connected to a Dow-Key DK77 relay, available with 12-volt coils for about $15 each at flea markets. You can select any spacing you want, and you can also use Tohutsu relays which are sold by Down East to provide a single T/R connection. Simply move the PA compartment down in the box and the relay will just fit on top.

You'll also note the small LED, switch, and RCA connector. The switch is used to go from receive to transmit, and parallels a line to the 5-pin power connector. I can key the unit either from my TS430S, or manually when using a 28MHz radio with no external keying. The LED indicates the transmit mode is active, and 12 volts is sent to the RCA jack in transmit to control a small relay. You could also incorporate a simple RF-sniffing TR switch if preferred to hard-wire control.

### Performance

I finished the entire kit and all chassis work you see here in two evenings, just in time for the 1992 ARRL UHF Contest. I used an outboard 100 watt solid-state amplifier and a single 21-element yagi to work about 25 stations from Richmond, Virginia, all the way up to New Hampshire. The DEM 432K provided adequate sensitivity, using a Kenwood TS-430S as the 10 meter exciter/receiver. Audio quality reports were excellent, and a small "FMing" problem was quickly fixed when I retweaked the crystal to a more stable position. Actual displayed frequency was within 1 kHz of my true location in the band when the crystal was set to peak output.

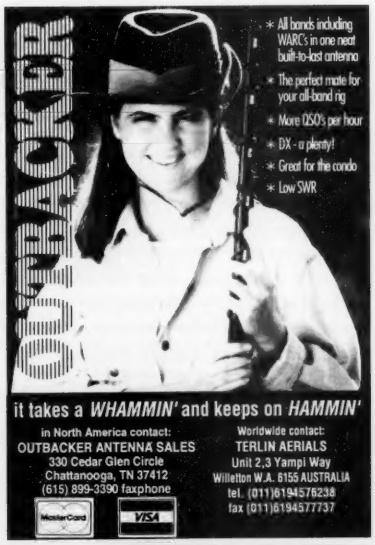
The DEM 432K heard signals (on the average) about 6 dB better than my Yaesu FT-790II transceiver without an external preamp. Plus, I measured greater than 0.15 µV sensitivity for 10 dB S/N on the bench, using an HP 608F signal generator. More importantly, the DEM 432K shows excellent linearity on the receive side, with a 1 dB compression point (without preamp) in excess of 0 dBm—a lot of signal!

### Conclusions

The DEM 432K represents an excellent value for the money. The kit is fairly easy to build if you use care in soldering and keeping track of the chip components. It gives you a complete 70 cm station, using your HF radio as an exciter, and all you'll need is an antenna and some coax to get up and running on SSB, CW, Packet, FM, and satellite operation.

The complete kit of three PC boards and a crystal sells for $155, while the add-on PA kit without enclosure comes in at $75, with the enclosure $135. The 432 MHz preamp kit sells for $30 without an enclosure, and you won't need the enclosure if it's mounted as shown. Assembled units are also available.

The PAC-TEC enclosures are available through a variety of distributors and retail for about $18 (#692-900) and $6 (#351-900). If you visit a few flea markets, you should be able to put a complete unit together for under $300.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### Loose Ends

I don't know about you, but the morning after a party I always find myself shuffling through the house, trying to clean up and put away loose ends. As the new year opens, I feel much the same way about the column this month.

To begin with, a correction. Somehow, the drawing for the VIC-20 I/O connector shown in the November issue of "RTTY Loop" got scrambled. The correct figure is shown here as Figure 1. It is important to note that, according to the information I was sent, there is no "G" or "I" terminal. This makes the pinouts different from the re-drawn illustration in November's magazine.

Next, a "thank you" to the readers of this column for coming to the aid of Charlie Anderson KG5SX. In July I related his tale of woe regarding a fried Hamsoft cartridge. In a letter just received, Charlie tells of several offers to extricate him from his situation, ranging from burning a new EPROM to helping with a whole new unit. Charlie is now set for digital, and thanks the readers of *73 Magazine* and "RTTY Loop" for the help. So do I!

### New Problems to Solve

I received a letter from Ralph Brown of Buffalo Grove, Illinois, looking for some guidance in setting up a RTTY receiving station. Not a ham (yet), Ralph has a Panasonic RF-2200 receiver, a HAL ST-5000 terminal unit, and a Model 28 KSR teleprinter, with gear sets for 100, 75, and 60 wpm. In addition, he has an Autek QF-1A SSB/CW/AM filter which, I believe, is an audio bandpass filter.

Well, Ralph, Figure 2 shows you the basic way to hook up your equipment. I have left the Autek filter out of the RTTY circuit, as the ST-5000 has internal filtering sufficient to deal with the audio output of the receiver. To follow the data path, start at the receiver. Audio from the receiver is routed first to the ST-5000, then to the speaker. You can do this in parallel, and a switch to cut off the speaker, so as not to annoy you with the "tweedle-dee," is a fine idea.

The loop supply goes, as you have indicated in your letter, to the loop input of the Model 28. If you have an oscilloscope, connect the horizontal and vertical inputs to the SCOPE Mark and Space connectors, and the ground of both inputs to the SCOPE Gnd connector, to see the common RTTY tuning cross pattern.

Now, with a mark signal tuned in, the machine should be quiet and just humming along. We can call this idling. With a space signal tuned in, the machine will be making all kinds of noise but printing nothing. This is running open.

Find a signal which sounds like a RTTY signal. This is characterized by a rapid frequency shift between the mark and space frequencies. After you've heard a few of these you'll get to recognize the sound; don't worry. Tune your receiver so that the signal strength is at a maximum on the S-meter, then adjust the beat frequency oscillator (BFO) so that the mark and space frequency pulses are detected by the demodulator.

If all is well, and the signal is Baudot, you should be receiving at this point. You say, "If the signal is Baudot? Say, what?" Well, here's the rub: Most commercial news services today regard Baudot encoding as as outmoded as spark. Unfortunately,

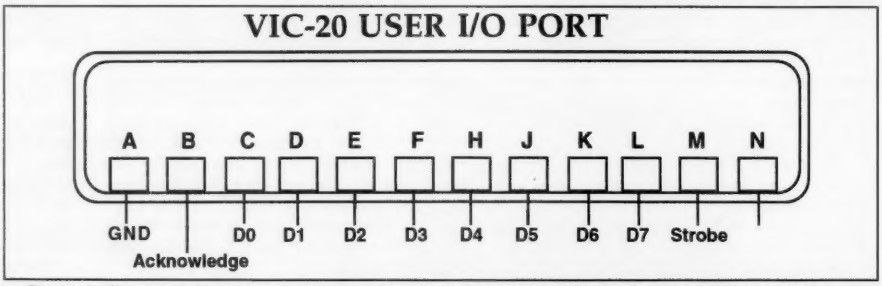


*Figure 1. Corrected diagram (see last month's column) showing the Commodore VIC-20 user I/O port.*

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the Model 28 teleprinter, upon which your system is based, is essentially locked into Baudot. More modern codes and code systems—ASCII, Sitor, and others—are foreign tongues to your machine. Yes, you can arrange a translation scheme to use the Model 28. Years ago, before the advent of cheap ASCII printers, such schemes were common, with codons such as ".LT." used to represent " ." Whew! Can you imagine a program listing printed that way? No thanks!

So, even if you can get this setup on the air, I am afraid you will be pretty much limited to ham transmissions and the rare commercial station still using five-level code. Several years ago we published a listing of commercial stations still on Baudot; I'm afraid it's hopelessly outdated now. I would be game to hear from any or all of you with information on recently heard Baudot stations.

Speaking of different modes of communication, e-mail received via CompuServe from Michael J. Golbey, M.D., VE7BLD, of Kelowna, British Columbia, addresses his AEA-FAX demodulator. He is wondering if anyone has any experience using the hardware for decoding any other forms of digital communications? For example, it is easy to "see" CW in the monitor mode. It should be possible to write software to display CW, RTTY, etc. Any suggestions would be much appreciated.

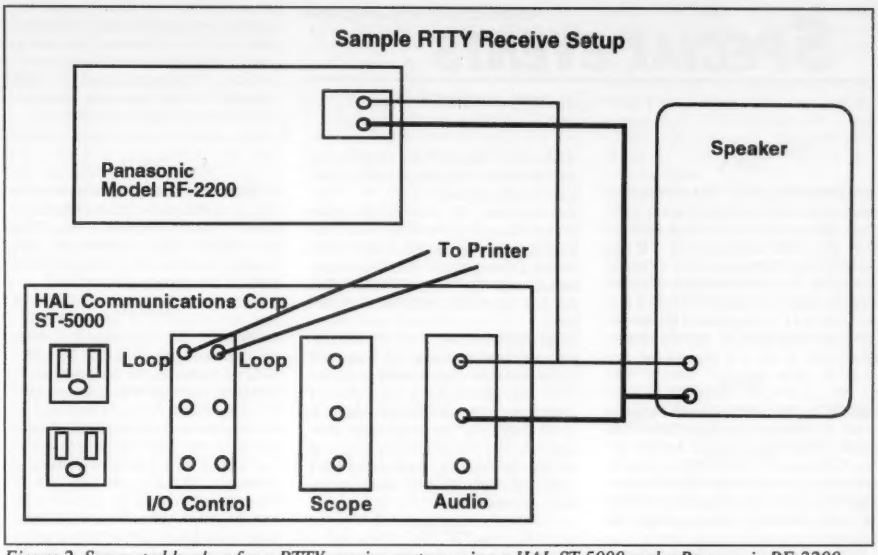


*Figure 2. Suggested hookup for a RTTY receive system using a HAL ST-5000 and a Panasonic RF-2200 receiver (rear view connections shown).*

Well, Mike, you got me! Let's wait and see what the folks out there say.

Such a way to begin a new year! Overall, I just can't wait to see what the mail brings this month. As always, feel free to drop me a note or e-mail at the above address, or on CompuServe (ppn 75036,2501), Delphi (username MarcWA3AJR), or America Online (screen name MarcWA3AJR). Of course, the disks remain available, both the "RTTY Loop" Software collection, and the archiving collection detailed last month. Just send disks, either 5 or 3+ inch, high or low density, a stamped disk mailer to return the disks to you, and $2 per disk to be filled. Each collection is over one megabyte in size, so be sure to include sufficient media for what you asked for, otherwise I will just pick and choose. Happy New Year everybody. May it be one of health, peace, and well being for each of us, our families, our nations, and the people of the world. 73


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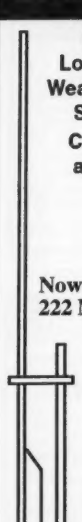

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### JAN 4

**CHATTANOOGA, TN** WCARS/VEC Exams will be held at Walker County (GA) Civic Center, US Hwy 27, Rock Springs, GA, at 7 PM. Contact *Alan Painter WA4QCH, 234 Wallaceville Rd., Rossville GA 30741; Tel. (404) 866-1200.* Alternate Contact: *Dale Harwood N4VFF, Rt.4 Box 297-B Hwy. 41 N, Ringgold GA 30732; Tel. (404) 937-5680.* Walk-ins normally accepted.

### JAN 9

**AUGUSTA, GA** VE Exams will be sponsored by Western Carolina ARS/VEC at Daniel Fields Airport General Aviation Office. Code tests at 10 AM, written elements at 11 AM. Contact *Jim Abercrombie N4JA, 2360 Travis Pines Rd., Augusta GA 30906; Tel. (404) 790-7802.* Walk-ins normally accepted.

**GREENVILLE, SC** WCARS/VEC Exams will be held at 8:30 AM at O'Neal Engineering Bldg., 850 S. Pleasantburg Dr. Contact *John E. Chism ND4N, 203 Lanewood Dr., Greenville SC 29607; Tel. (803) 288-0136.* Walk-ins normally accepted.

**MIDDLESBORO, KY** WCARS/VEC sponsored VE Exams will be held at 10 AM at the Middlesboro City Library. Contact *Andrew A. Pitt WB8WEZ, P.O. Box 2164, Middlesboro KY 40965; Tel. (606) 248-0046.* Alternate Contact: *James E. Dyke KZ8A, RR 1 Box 295 AA, Cumberland Gap TN 37724; Tel. (615) 869-4453.* Walk-ins normally accepted.

**MORRISTOWN, TN** WCARS/VEC Exams will be held at 7:30 PM at the Red Cross Bldg. Contact *Roy Zeigler KF4CB, 2261 Warren Dr., Morristown TN 37814.* Alternate Contact: *D.C. Gluck WD4FOX, P.O. Box 335, Talbott TN 37877; Tel. (615) 586-2041.*

**WEST MEMPHIS, AR** The WCARS/VEC will conduct VE Exams at the Rosewood United Methodist Church, 2303 E. Barton Ave., at 9 AM. Contact *Gene Bagley AB5BL, Rt.1 - Box 13, Dunhill Rd. N, Marion AR 72364; Tel. (501) 739-4029.* Alternate Contact: *Rev. Richard Gregory AB5CH, 824 Pryor Dr., West Memphis AR 72301; Tel. (501) 735-4060.* Walk-ins normally accepted.

### JAN 10

**JASPER, TN** WCARS/VEC Exams will be held at the Jasper Public Library at 1 PM. Pre-registration preferred. Mail Form 610, copy of any license, copy of any CSCE, and check for exam fee (made payable to WCARS/VEC) to contact person. If no one pre-registers, the session will be cancelled. Contact *Charles Wooten KD4XX, 103 W. 7th St., Jasper TN 37347; Tel. (615) 942-5116.* Alternate Contact: *Wallace S. Brown KD4XV, 409 Magnolia Ave., Jasper TN 37347; Tel. (615) 942-2836.*

### JAN 11

**ATHENS, TN** WCARS/VEC Exams will be held at 8 PM at the Athens Municipal Building, Council Chambers. Contact *Evan Ray WA4PNI, 529 N. Washington Ave., Etowah TN 37331; Tel. (615) 263-9300.* Walk-ins normally accepted.

### JAN 16

**CAMERON, MO** The Missouri Valley ARC, Green-Hills ARC, and Ray-Clay ARC, will co-sponsor the 3rd annual Northwest Missouri Winter Hamfest from 9 AM-4 PM at the KMRN Tri-Rivers Expo Hall on US 69, one mile north of I-35 exit 48 (Wallace State Park exit). FCC Exams. Indoor Flea Market. Free Parking. Tickets $2 in advance or 3/$5; $3 at the door or 2/$5. Pre-registration requests received after Jan. 4th, 1993, will be held at the door. Swap tables $9 ea. for the first two tables. Commercial exhibitors welcome; write for details. Talk-in on 146.52 and 446.00 simplex. Contact *Northwest Missouri Winter Hamfest, P.O. Box 182, Cameron MO 64429.*

**CHARLESTON, SC** WCARS/VEC Exams will be held at Trident Technical College at 9 AM. Contact *Pat Foster AC4IH, 117 Keenan Ave., Goose Creek SC 29445; Tel. (803) 553-3871.* Alternate Contact: *Werner E. Dolder AA4IX, 327 Heber Rd., Summerville SC 29483; Tel. (803) 873-9465.* Walk-ins normally accepted.

**HAMMOND, LA** The Southeast Louisiana ARC will sponsor the 1993 Hammond Hamfest, to be held in the SLU University Center from 9 AM-4 PM. Free admission. VE Exams. ARRL and QCWA Meetings. Free Swap Tables (limited number). Commercial vendors may setup Fri. afternoon. Contact *Ernest Bush N5NIB, 331 Rock Rd., Hammond LA 70403; Tel. (504) 567-1261 (days); (504) 542-0034 (eves.).*

**KNOXVILLE, TN** VE Exams, for Upgrades only, will be held at Pellissippi State Technical Community College, Room B-129 (formerly STIK, Pellissippi Campus). Code tests at 10 AM, 10:20 AM and 10:40 AM. All written elements at 11 AM. Pre-registration requested. Send Form 610, copy of license and any CSCE, and a check for the exam fee (payable to WCARS/VEC) to be received by the day before the test. Registrations will be accepted in the exam room until 9:30 AM - none later. Contact *Ray Adams N4BAQ, 4325 Felty Dr., Knoxville TN 37918; Tel. (615) 688-7771.* Alternate Contact: *Rich Slover ND4F, P.O. Box 30754, Knoxville TN 37930; Tel. (615) 539-4821.* Novice testing on request from N4BAQ, ND4F, WA4GZE, N4IJL, W4MHA, WA4TKN and others.

**LOUISVILLE, KY** VE Exams will be held 10 AM-2 PM at the Government Center, Outer Loop 3 mi E I-65. Walk-ins only. Contact *Otis Herron AA4HJ, 4810 Hood Rd., Louisville KY 40213; Tel. (502) 969-*


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7332. Alternate Contact: *Bob Happel N4LGX, 2012 Ben Ali Rd., Louisville KY 40223; Tel. (502) 425-5260.*

**MONTEREY, CA** The Naval Postgraduate School ARC will sponsor their 4th annual NPSARC Winterfest at Monterey Peninsula College Armory, from 8 AM-1 PM+, rain or shine. Free admission. Commercial vendors. Indoor Flea Market, $10 per space. Demonstrations. Outdoor Tailgate Market, $5 per space. Talk-in on 146.97-. Contact *Doug KC3RL, 9 Glenn Ave., Prunedale CA 93907; Tel. (408) 663-6117.* Or call *Pat KA6IRS, (408) 649-4444 ext. 20 (days only).*

**SPINDALE, NC** WCARS/VEC Exams will be held at 10 AM at Isothermal College. Contact *A.B. Brackett KO4BJ, Rt. 2 Box 242, Bostic NC 28018; Tel. (704) 245-6334.* Alternate Contact: *F. Bruce Tessinear KD4OJ, P.O. Box 341, Henrietta NC 28076; Tel. (704) 657-5464.*

### JAN 17

**SOUTHFIELD, MI** The Southfield High School ARC will sponsor their 27th annual Hamfest/Electronics/Computer Swap & Shop at Southfield High School, 24675 Lahser. Doors open at 6 AM for exhibitors. Open to the public 8 AM-3 PM. Admission $4, children 12 and under free. Tables reserved and paid for in advance @ $15 for each 8' table (admission ticket required). For tickets and tables, send SASE with check (made payable to Southfield High School) to *Robert Younker, Southfield Senior High School, 24675 Lahser Rd., Southfield MI 48034.* For info, leave a message at *(313) 746-8675.* Long distance replies will be collect. Table reservations are on a first-come, first-serve basis. Indicate if you need electricity, and also, please indicate the kind of material you have for sale.

**SUMTER, SC** WCARS/VEC Exams will be held at 8:30 AM at Abundant Faith Church. Contact *Dan Mask WB5SGH, 404 Sanders Dr., Sumter SC 29150; Tel. (803) 775-9106.* Walk-ins normally accepted.

**YONKERS, NY** There will be a Giant Electronic Fleamarket at the Lincoln High School, Kneeland Ave., off Yonkers Ave., from 9 AM-3 PM, rain or shine. Free Parking. Admission $4, kids under 12 free. Indoor Flea Market only. Set-up at 7 AM. No tailgating! VE Exams. Sellers: $15 1st table, $10 ea. addt'l. table. All tables 30"" x 5'; or bring your own table at $1.80 per ft.—min. $10. Full payment due with registration by Jan. 10th. No paid reservations for tables or space will be held past 9 AM. No refunds unless notification of cancellation has been received 72 hours in advance of the event. Tables are $20 at the door, or $2.50 per ft. For registration: *Otto Supliski WB2SLQ, (914) 969-1053.* Mail paid reservations to: *Metro 70 cm. Network, 53 Hayward St., Yonkers NY 10704.* Talk-in on 440.425 MHz PL 156.7, 223.760 MHz PL 67.0, 146.910 MHz, 443.350 MHz PL 156.7.

### JAN 18

**JAMESTOWN, TN** WCARS/VEC Exams will be held at the First Baptist Church at 7 PM. Contact *Mike Ledbetter AB4BX, Rt. 4 Box 759, Jamestown TN 38556; Tel. (615) 879-8626.* Alternate Contact: *Fred Davis K8DOC, 17 Sleepy Hollow, Jamestown TN 38556; Tel. (615) 879-9268.* Walk-ins normally accepted.

### JAN 22

**ELIZABETHTON, TN** WCARS/VEC Exams will be held at Moody Aviation - Carter County Airport at 7 PM. Applicants must be pre-registered the day before the test session. Contact *Joe Hopkins K4BKI, 414 East H. St., Elizabethton TN 37643; Tel. (615) 543-4022.* Alternate Contact: *Jon Christiansen AB4NN, Echo Dr., Elizabethton TN 37643; Tel. (615) 543-7155.*

### JAN 23

**ASHEVILLE, NC** WCARS/VEC Exams will be held at 9 AM at the Health and Social Services Bldg. Contact *Norman G. Harrill N4NH, 7 Skylyn Ct., Asheville NC 28806; Tel. (704) 253-1192.* Walk-ins normally accepted.

**CRYSTAL RIVER, FL** The 13th Annual Citrus County Hamfest/Computer Show, sponsored by the Sky High ARC, will be held at the National Guard Armory located on Seven Rivers Dr., just south of the Crystal River Airport off route US19. Starts at 8:30 AM. All items to be 80% HAM related. Free Parking. Tailgating. Self contained RV parking. Set-up from 3 PM-5 PM Fri., and 7 AM-8:30 AM Sat. 120V AC available at no charge (users must provide plugs, cords, and tape, where cords cross aisles). Admission $4 until Jan. 9th, then $5 thereafter. XYL's free with OM. All exhibitors and helpers *must* purchase admission tickets. Indoor tables $15, chair provided. Outdoor spaces $8 (does not include tables, chairs or power). All tables are 30" x 8'. Telephone reservations 10 AM-9 PM only. Payment must be received within 7 days or reservation will be cancelled. Confirmation mailed on receipt of payment and SASE. Talk-in on 146.355/.955. Call *Billy WE4C, (904) 726-2905, 10 AM-9 PM.* Write: *SHARC Hamfest, 8811 Maplewood, Ivemess FL 34450.*

**GALLATIN, TN** VE Exams will be held at 11 AM at the Red Cross Bldg., S. Water Ave. By Pre-registration only. Contact *Ronnie L. Gilley KA4LUG, 512 Hillside Ln., Gallatin TN 37066; Tel. (615) 452-0883.* Alternate Contact: *Jerry Goodchild K4DZR, 233 Sterling Rd., Hendersonville TN 37075; Tel. (615) 824-7699.*

**GREENEVILLE, TN** WCARS/VEC Exams will be held at Roby Adult Center, 203 N. College St. at 10 AM. Contact *Jack Creed K4EPC, 826 Redbud Dr., Greeneville TN 37743; Tel. (615) 638-7056.* Walk-ins normally accepted.

**MEMPHIS, TN** VE Exams will be held at 9 AM at Central Church, 6655 Winchester Rd. Contact *Win Guin W2GLJ, 2138 Sonning Dr., Germantown TN 38138; Tel. (901) 754-4552.* Alternate Contact: *Nita Wofford N4DON, 2966 Cordell St., Memphis TN 38118; Tel. (901) 363-4971.* Walk-ins normally accepted.

**NEW BERN, NC** VE Exams for Walk-ins only, will be held at 9 AM at New Bern High School. Contact *Andy Griffith W4ULD, 203 Lord Granville Dr., Rt. 2, Morehead City NC 28857; Tel. (919) 726-5924.* Sponsored by WCARS/VEC.

### JAN 23-24

**GALLATIN, TN** The Tennessee Valley AR Network will hold its 3rd annual Middle Tennessee Hamfest/Packet Conference at the National Guard Armory on Hwy. 25 East. Set-up Fri. Noon to 6 PM; Sat. 5 AM-8 AM. Open Sat. 8 AM-4 PM, Sun. 8 AM-2 PM. Admission $5 each day; XYLs and under 16 FREE. Tables $10 for both days (includes 1 admission). VE Exams. Register Sat. 9 AM-11 AM. Pre-registration guarantees exam. Testing begins at 11 AM. Packet forums both days. Talk-in on 145.13-, 147.30+ and 442.600+, starting at 10 AM Fri, 5 AM Sat., 7 AM Sun. Contact *Bill Ferrell, (615) 452-3962 after 5 PM M-F; anytime S-S;* or write *TVARN, 1120 Douglas Bd. Rd., Gallatin TN 37066.*


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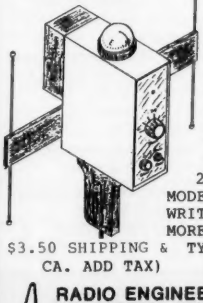

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### JAN 31

**DOVER, OH** The TUSCO ARC Hamfest will be held at the Ohio National Guard Armory, 2800 N. Wooster Ave., starting at 8 AM. Set-up at 6 AM. Admission Free. Tables $8 ea. Talk-in on 146.730 W8ZX rptr. Contact *Howard Blind KD8KF, 6288 Echo Lake Rd. N.E., New Philadelphia OH 44663; Tel. (216) 364-5258.*

**WHEATON, IL** Wheaton Community Radio Amateurs Mid-Winter Hamfest will be held at the Odeum Expo Center, Villa Park, IL, beginning at 8 AM. EZ access from major X-ways. NOW VEC Testing. Flea Market and Commercial tables available on reserved basis. Free and paid parking. Handicap access. Women's programs. Free shuttle bus. Seminars and more. Tickets $5 in advance w/3 drawing stubs; $6 at the door w/1 stub. Talk-in on 14.390. Contact *Wheaton Community Radio Amateurs, P.O. Box QSL, Wheaton IL 60189; Tel. (708) 629-8006* or *(708) 629-8889.*

### FEB 6

**KNOXVILLE, TN** The Shriners of the Kerbela ARS, Kerbela Shrine Temple, will sponsor KERBELA HAMFEST (was Sevierville) at the Kerbela Temple from 8 AM-4 PM. Admission $2. Tailgating $3 plus admission. Tables $8. Set-up 4 PM-9 PM Fri., and 5 AM-8 AM Sat. No crafts allowed. Smoking in designated area only. Talk-in on 146.34/.94. For table info, contact *Paul Baird KY4A, 1500 Coulter Shoales Circle, Lenoir City TN 37771; Tel. (615) 986-9562).* FCC Exams by WCARS-VEC. Pre-registrations until 9:30. Code test begins at 10 AM. Written test follows at 11 AM. Mail completed Form 610 with check for $5.40 (payable to WCARS/VEC) to *Ray Adams N4BAQ, 5833 Clinton Hwy., Suite 203, Knoxville TN 37912-2545. Tel. (615) 688-7771).*

**LANCASTER, PA** A Dutch Country Computer and Communications Show will be held at the Lancaster Host Golf Resort and Conference Center on US Route 30 east. Sponsored by the Columbia Area ARC, Inc. For info, contact *CAARC, P.O. Box 574, Columbia PA 17512; Tel. (717) 627-1597.* For Vendor info, *Fax (717) 872-0857.*

### FEB 27

**LaPORTE, IN** The LaPorte ARC will host a Hamfest at the LaPorte Civic Auditorium, 1001 Ridge St., beginning at 8 AM. Set-up at 6 AM. Admission $4 at the door (no advance). Tables, $5 prepaid. Send payment, with SASE to *LPARC, P.O. Box 30, LaPorte IN 46350.* Talk-in on 146.610.

## SPECIAL EVENT STATIONS

### JAN 15-18

**WASHINGTON, DC** MADRAS, the Maryland Apple Dumpling ARS, Inc., will operate W3USS at the Russell Senate Office Bldg. on Capitol Hill, to commemorate the inauguration of the 42nd President of the United States, Bill Clinton and Vice President Albert Gore. Operation will take place from Fri. Jan. 15th, 2300Z-2300Z Mon. Jan. 18th. Frequencies: Phone—1.855, 3.905, 7.205, 14.270, 21.345, 28.490 MHz; CW— 1.810, 3.640, 7.050, 14.050, 21.050, 28.050 MHz. Each evening the Station will operate CW in the bottom of the Novice bands; 80m 7PM-8 PM, 40m 10 PM-11PM E.S.T. The operator will adjust his code speed to that of the calling station. For certificate, send 9 x 12 SASE to *MADRAS, Box 2468, Wheaton MD 20902, U.S.A.* Visitors to the Virginia, DC and Maryland area needing help or info, contact *MADRAS 145.45, 444.1 or 146.505 simplex.*

### JAN 23

**AUBURN, NY** The Auburn ARA will operate KC2VB from 1500Z-2100Z to celebrate the bicentennial of the founding of Auburn and Winterfest. Operation will be in the lower 25 MHz of the General 40, 20, 15, and 10m bands, and the corresponding Novice bands. For a certificate, send a 9 x 12 SASE to *Stan Gutelius KC2VB, 4 Elizabeth St., Auburn NY 13021.*

### JAN 23-24

**EVANSTON, WY** The Uinta County ARC will operate NW7H 1500Z-2400Z, to celebrate the Chinese New Year, in the only city in the Rocky Mountains observing this holiday. Phone 10X on 28.395, 24.945, 21.325, 18.140, 14.245, or CW on 7.122. For a certificate, send your QSL with 9 x 12 inch SASE to *Vranish, P.O. Box 2048, Evanston WY 82931-2048.*

### JAN 28

**SAN DIEGO, CA** The Challenger Junior High School ARC will operate KI6YG from 1500Z-2400Z, to commemorate the Challenger Space Shuttle tragedy that occurred on this date seven years ago. Frequencies: 14.270, 21.270, and 28.270. For a special QSL card, please send your QSL and SASE to *Frank Forrester KI6YG, Challenger JHS ARC, 10810 Parkdale Ave., San Diego CA 92126.*

### FEB 5-6

**VERMONT** The Central Vermont ARC (W1BD), and The Burlington ARC (W1KOO), will be multipliers for The 30th Annual Vermont QSO Party. 24 hours only! 7 PM Fri.-7 PM Sat. EST. All licensed amateur radio operators are invited to participate. Frequencies: Phone—160-10m. First 25 kHz up from the beginning of General phone band privileges, and Novice phone 10m privileges. CW—40 kHz up from the bottom edge of the bands and 20 kHz up from the bottom of Novice portions. VHF—50.200, 144.200, and 146.49 MHz. Other modes in the customary section of the respective band. Repeater contacts not allowed. Exchange: VT stations send RS(T) and County. CW two-letter designator as follows: AD, BN, CL, CH, ES, FR, GI, LM, OG, OL, RT, WA, WM, WR. Other stations send RS(T), state, province, or DX-CC country. Scoring: VT stations count 1 point per phone contact, 2 points for CW, digital, ATV etc. Multiply by number of VT counties, states/provinces/countries, W1BD and/or W1KOO QSOs. Other stations count 1 point per VT phone contact; 2 points per VT CW, digital or ATV contact. Multiply by number of Vermont counties and W1BD and/or W1KOO QSOs. A station may be worked twice per band: one phone contact and one other type mode per band. Awards: VT stations submitting a log will receive a Special Certificate. Plaques will be awarded to the 3 highest scoring VT stations. Other stations receive Special Certificate for highest scoring station in each state/province/country. The WVT Award is given to stations working 13 of Vermont's 14 counties. Send logs/facsimilies, name, address, call, whether single or multioperator, postmarked no later than March 1, 1993 to: *Bob DeForge K1HKI, RR1 Box 271, Brookfield VT 05036.* Please send SASE for results.


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| 16 | Astron Corporation ....23 |
| 17 | ATV World ....57 |
| 140 | Aviacomm Publications ....50 |
| 21 | B & B, Inc. ....70 |
| 41 | Barry Electronics Corporation ....21 |
| • | BB & W Printing....19 |
| 42 | Bilal Company ....76 |
| 176 | Bird Electronics ....15 |
| • | **Black Belt Systems ....80** |
| 137 | Box Products ....63 |
| 56 | Buckmaster Publishing ....70* |
| 170 | Buckmaster Publishing ....84* |
| 7 | Buckmaster Publishing ....80* |
| 168 | Buckmaster Publishing ....63* |
| 222 | Byers Chassis Kits ....19 |
| 184 | C & S Sales, Inc. ....45 |
| • | CB City International ....35 |
| 123 | CCTV ....53 |
| • | Cellular Security Group ....63 |
| • | Charlotte Hamfest ....27 |
| 265 | Chipswitch ....50 |
| 156 | Commpute Corporation ....85 |
| 99 | Communication Concepts, Inc. ....45 |
| 10 | Communication Specialist....54* |
| **268** | **Computer Automation Technologies ....53** |
| 15 | Comtelco ....63 |
| 12 | Connect Systems ....65 |
| 146 | Creative Control Products ....91 |
| • | Dayton Hamvention....89 |
| • | Diamond Antenna ....2* |
| 288 | Digital Interactive....73 |
| 231 | Douglas RF Devices....83 |
| 229 | Douglas RF Devices....77 |
| • | Down East Microwave....17 |
| 114 | E. H. Yost ....63 |
| • | Eavesdropping Detection ....73 |
| **157** | **Echotrak ....73** |
| • | Electron Processing....19* |
| • | Electronic Distributors ....65 |
| • | Electronics Book Club ....31 |
| 8 | Elktronics....85 |
| • | Emcom Industries....82 |
| • | Enterprise Radio Applications ....43 |
| • | Gap Antenna Products....59 |
| • | Get-Tech....87 |
| 193 | GGTE....91* |
| 72 | Glen Martin Engineering....27 |
| 291 | Gracilis ....55 |
| 192 | Grapevine Group....27 |
| • | Hamtronics, Inc. ....7 |
| 182 | Handie-Base....73 |
| 284 | Heights Tower Systems....43 |
| **293** | **IC Engineering....35** |
| 179 | Icom ....CV2* |
| • | Indiana Hamfest ....19 |
| 293 | Innotek, Inc....83 |
| 42 | Isotron ....76 |
| 3 | ITC....1 |
| 3 | ITC....39 |
| 295 | Itech....78 |
| 246 | J&W Technologies....75 |
| 55 | J-Com....59 |
| 55 | J-Com....44 |
| 159 | Japan Radio ....51 |
| **148** | **JLP Computers & Electronics....78** |
| • | K-Comm ....73 |
| 46 | K-Quest Software....79 |
| 2 | Kawa Productions ....79 |
| **151** | **KDC Sound ....82** |
| • | Kenwood USA Corporation....CV4 |
| • | Kenwood USA Corporation....5 |
| 234 | Lentini Communications....64 |
| • | **Let's Talk Radio Network....71** |
| 47 | Link-Com ....41 |
| **243** | **Luke Company....84** |
| 25 | Madison Electronic Supply....63 |
| • | Meadowlake Corporation ....82 |
| 86 | MFJ Enterprises ....11 |
| 162 | Michigan Radio....15 |
| 144 | Micro Control Specialities....53 |
| 30 | Micro Video Products ....84 |
| 98 | Microcraft Corp....63 |
| 248 | MoTron Electronics ....80 |
| 64 | Mouser Electronics....15 |
| 141 | Namlulu Communications ....80 |
| 223 | National Amateur Radio ....76 |
| 54 | NCG ....61 |
| 114 | Mr. Nicad ....63 |
| 1 | Number One Systems Ltd. ....55 |
| 290 | Nye Engineering....84 |
| • | O.F.S. Weatherfax....59 |
| 82 | Oak Hills Research....83 |
| • | Oklahoma Comm Center....76 |
| 102 | ONV Safety Belt ....63 |
| 172 | Optoelectronics ....37 |
| 96 | Orlando Hamcation ....55 |
| 262 | Outbacker Antenna Sales ....75 |
| • | P.C. Electronics....57* |
| • | P.C. Electronics....68* |
| 264 | Palomar Telecom....68 |
| 139 | Palomar Telecom....83 |
| • | Peet Brothers ....67 |
| 68 | Periphex ....33 |
| 198 | Personal Computer Repeater Controller....63 |
| • | Personal Database....67 |
| 249 | Phillips Industries, Inc....84 |
| 145 | QSO Software ....66 |
| 132 | Quement Electronics ....49 |
| 132 | Quement Electronics ....61 |
| 147 | R.L. Drake Company....57 |
| 110 | Radio Amateur Satellite....71 |
| 58 | Radio Engineers....79 |
| • | Radio Fun....81 |
| • | RAI Enterprises....79 |
| 34 | Ramsey Electronics ....25* |
| • | RF Parts Company ....2* |
| 134 | Rose....35 |
| 254 | Ross Distributing ....80 |
| • | RT Systems....85 |
| 32 | Ryan Communications ....50 |
| • | The Ham Center....73 |
| • | SAM....85 |
| 153 | Satellite City....45* |
| 36 | Scrambling News ....83 |
| 167 | Sescom, Inc....76 |
| 188 | SGC Inc....69 |
| 250 | Software Systems ....43 |
| 244 | Software Systems ....77 |
| 183 | Spectrum International ....40 |
| 97 | Spread Spectrum Scene ....67 |
| 247 | Startek....13 |
| 232 | TE Systems....19 |
| 124 | Texas Bug Catcher Antenna ....19 |
| 6 | The Antenna Specialist ....33 |
| 269 | Tigertronics....54 |
| 154 | Timewave Technology....33 |
| 299 | Townsend Electronics....82 |
| 11 | Transel Technologies ....17 |
| 22 | Tri-Ex....49 |
| 166 | Trionics....77 |
| 50 | Tropical Hamboree....59 |
| • | Uncle Wayne's Bookshelf....94,95 |
| 190 | U.S. Digital ....91 |
| • | Universal Radio....41* |
| • | Vanguard Labs ....79 |
| 70 | Vectronics Corporation....49 |
| 48 | Ventek ....73 |
| 259 | Versatel Communications....82 |
| 14 | VHF Communications ....78 |
| 104 | Vis Study Guides, Inc. ....70 |
| 191 | W & W Associates....41 |
| 292 | Walker Scientific, Inc. ....61 |
| 20 | Wolfe Communications ....83 |
| 94 | Xpertek....63 |
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## NEVER SAY DIE

*Continued from page 67*

the body is in danger. This response works on a very fundamental level, operating through what we consider as instincts. Though we quickly become aware of pain on a conscious level, we realize that by that time we've already reacted to it subconsciously. If we had to wait for the pain message to reach the conscious mind and tell us to take our hand off the stove, we'd do a lot of damage. No, the hand jerks off way before we know what hit us.

We learn from this. The next time we see a stove we're suddenly careful and tend not to touch it. This isn't entirely a conscious matter, it's a built-in reaction. Pain equals the vision of the stove on a subconscious level. Well, this is often a very valuable survival system. But like any system that works automatically, it's often going to be wrong and send false alarms.

On a completely subconscious level the mind equates pain with all perceptics being received at the same time . . . visual, sonic, and so on. By the time we have thousands of pain incidents the brain is fairly well tied up with neurons dedicated to these pain avoidance equations. I found this out personally when I worked with people under hypnosis removing these pain equations and discovered that their IQs were measurably zooming upwards and their mental awareness was going higher and higher.

So what's all this got to do with the prenatal period? Well, the avoidance of pain system seems to be so fundamental that it's in operation right from the beginning. So what pain does a fetus experience? The baby gets all its food directly from the mother through the umbilical cord, right? This means the baby is in tune with the mother. When the mother is in fear her system shoots adrenaline into her blood to help her fight or flee. I hope you won't think it surprising that this chemical attack also shocks the baby. The baby records the sounds being heard and equates them to the adrenaline shock. The sounds are recorded, just as they would be on a tape recorder. The baby doesn't understand what words mean, but in later life that word pattern is going to be equated with a shock to the system and the baby is going to subconsciously react negatively.

Now, the next step in this process. If you think of the baby's mind as acting a good deal like a computer you won't be far off. It's a computer far beyond anything we can even hope to build yet, but it does act like a computer in many ways. The baby gradually learns to deal with its environment. It's very comfortable most of the time during the prenatal period. The temperature is perfect. The food is great. And there's the comfort of a sort of spiritual communication with the mother.

Babies are programmed very much like computers in that the early instructions are the foundation upon which later instructions are built. If you start with a weak or faulty foundation, no amount of later patches are going to give you the perfection you'd have had without the bad foundation. Make sense? Now do you see why I attach so much importance to what happens during pregnancy?

When mothers don't eat right this permanently affects the child. No amount of good food later on will ever make up for it. When the mother drinks alcohol this zaps right down to the baby. This is traumatic. This is pain! Is it any wonder that the children of mothers who drink during pregnancy have so many problems later on? And the fact is that we're just beginning to find out how many problems this can generate. We know it affects intelligence and health. Well, the same goes for nicotine. When the mother smokes, the nicotine hits the baby like a sledge. Wham! Other stimulants such as caffeine also register as shocks to the fetus. And I don't have to explain how drugs can not just screw up the genetic development of the baby, but set up all sorts of bum basic programming.

There are other shocks which register with the baby such as when the mother falls down or is hit in the stomach. All of these shocks are duly recorded, right along with the sound patterns for later avoidance.

The birth process is enormously traumatic. Families who are aware of the importance of keeping these pain avoidance equations to a minimum insist on the birth being kept as quiet as possible. No talking. No unnecessary sounds. For years doctors scoffed at this silly notion, but recent research has proven how important a quiet birth can be, so we have fewer skeptics now.

The more we can help women understand the importance to their child of their health, the food they eat, the need to avoid chemical attacks on the baby, and the need for silence when there's a chance the baby might be feeling pain, the better will be the most basic programming of the child.

So how about sex during pregnancy? The baby is going to enjoy this right along with the mother as the pleasure chemicals reach it and the feeling of happiness is shared.

A few people are working on ways of going back under hypnosis and erasing these early pain memories. You can read more about this in *The Holotropic Mind* by Grof (1990—$20), if you're interested. The first work in this area was described by Alfred Korzibski in his *Science and Sanity* (1935). I plan to write on the nuts and bolts of how to do the repair job when I have the time. But it's a lot easier and cheaper to be careful and not mess up a child's development


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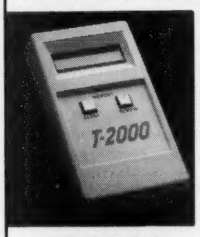


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during the first nine months, the most basic of all learning periods. I hope this makes sense to you.

**Age #2**

The second most important educational period is from birth through to about the first birthday. And if you think we're screwing up our children during pregnancy, wait'll I explain what we've been doing to the little darlings after they're born. You're not going to like this.

Let me ask a very basic question. How important is your child to you? How important is it that your child be given every opportunity to grow up to be the best kind of person you can manage? Would you do anything knowingly that would permanently cripple your child? Would you do anything knowingly which would result in your child having a low IQ? Would you do anything that would tend to have your child become a drug addict? To be an alcoholic? To be a misfit in society? To become a criminal?

What's it worth to you to be fairly sure that your child will grow up to be healthy, intelligent, happy, have a good marriage, and be successful in life? No psychoses? No allergies? If you handle your child's education on every level according to what we know now about how children develop, you'll have a good chance at producing a terrific winner.

Which brings me back to birth, a process which we've managed to louse up almost beyond recognition. So what happens to the kid when you shoot the mother full of drugs so she won't have to feel the pain? Babies need all of the strength they can muster to cope with the birth process. The last thing they need is to be drugged.

Now let's tackle the biggest problem we have with birth, which is what happens immediately after. Think about this for a moment. For thousands of generations children were born and immediately put with their mothers. The child has just spent a few months being fairly close to its mother. It's bad enough to have to get the lungs going and shift to air and breast food, but then to go against a basic instinct by taking the baby away from the mother, it's no wonder babies cry and are traumatized.

We recognize the power of instinct in birds, animals, insects, reptiles and so on. So why are we so blind to human instincts? Do we even for a moment deny they exist? When we look at primitive tribes we find that children are put with their mothers immediately after their birth. Further, they stay with their mothers night and day until they learn to crawl.

The hospital nursery is a cruel, painful time for babies. It goes against hundreds of thousands of years of instinct. When babies are put with their mothers they don't cry. When they are allowed to stay with their mothers they don't cry.

Allowing babies to stay with their mothers day and night for the first year is going to be even more difficult a change. Our society isn't geared for this. Oh, we're beginning to recognize that mothers should have a few weeks with their babies. We're seeing moves towards maternal leaves from work. We've got to do more than that.

Just the other day I was watching a PBS program showing how young children are treated in various countries. One of the groups visited was a primitive tribe. Here the babies were kept with the mothers. Mothers carried their babies around with them everywhere. The interesting part was that in this situation none of the babies cried. And as they grew up they didn't fight with other children. The kids all happily lent a hand with their younger siblings when needed.

If the whole concept is interesting you'll enjoy reading *The Continuum Concept* by Jean Liedloff (1991—$9). The subtitle is, ` `Allowing human nature to work successfully.' ' You'll see why I recommend that businesses encourage mothers to bring their babies with them to work. It'll make happier mothers and babies.

When we separate babies from their mothers we're going against eons of instinctive behavior. What a great introduction to the outside world! The baby doesn't think, it reacts. It knows something is terribly wrong so it cries. After nine months of being warm and protected by the mother babies need to feel her next to them. They need to feel her warmth, her voice, her touch. They need to feed when they feel hungry.

Perhaps you've noticed that your body tells you in no uncertain terms when it needs food. If you delay the message gets more painful. This is self-preservation at work. Babies feel the same thing, only it's a much more powerful urge for them and traumatic when not fulfilled immediately. Pain! And that means more negative programming of this new computer system. Is it any wonder we're such psychological messes a few years later? Is it any wonder we're all having to diet . . . or at least should?

It's going to take some re-education to change our society so it gives babies the best educational start we can. This means understanding how what we do affects babies during pregnancy. And it means changing things so mothers can keep their children with them for the first few months . . . until they are ready to separate on their own . . . instinctively. Once they're ready they'll start crawling and exploring. Then they'll gradually adjust to being separated from mother and we'll get into Age #3, that time from around the first birthday


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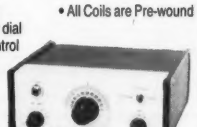

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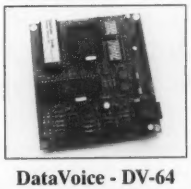

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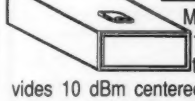

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until their formal education starts in school.

This approach should make sense and appeal to most people, despite the need for changes in our society. It fits in with what we know. And if we can bring it off we're going to have far happier, intelligent and better motivated kids.

There are some less obvious influences on babies that we'll eventually have to deal with. We can see some of these at work with other animals. You've seen the way schools of fish can change direction instantly. We've seen how people can change when they are in a group. We need to understand more about how mob psychology works. What turns individuals into a lynch mob? Into a cheering political group? Into mass-hypnotized rock 'n' roll groups? Into feeling a group religious experience?

And how do we deal with mental communications which occur on a subconscious level and are thus extremely elusive to study? If I'm encouraged to explain how to repair the mind . . . how to find these pain avoidance memories and erase them . . . then we're going to get deeper into the metaphysical. Then we're going to start dealing with life, death, past lives, reincarnation, and other things that are outside our normal Newtonian, Aristotelian everyday world.

It's a lot simpler to accept the obvious. The sun comes up every day, so obviously the sun is rotating around the earth. Do you know that there is a fair percentage of Americans who don't understand that the earth circles the sun? When we look at matter we know it's there. We can see it and feel it. Then we go to school and find out that matter is made up of molecules. Molecules are made up of atoms. And atoms are made up of electrical charges all held in place by forces which we don't see, feel or experience in everyday life. Newtonian physics doesn't hold when you get outside of our normal frame of reference. Nor does Aristotelian logic.

Quantum mechanics doesn't make any Newtonian sense at all. We're changing electrons into photons and back. We're splitting photons and suddenly we're defying time. Well, this is where we're getting in our understanding of how the brain-mind-spirit-body work. A book you'll find absolutely fascinating is *The Holographic Universe* by Michael Talbot (1991—$10). But get a good grip on yourself because you're in for a wild ride . . . and you'll never be the same again.

As you begin to understand how the mind and body are integrated you'll see where I'm headed when I suggest we investigate how the mind works as a better approach to health care than just treating germs, viruses, and other symptoms. I suspect that for about the same investment it takes to bring one new drug to the market we could prevent around 90% of sickness via tackling the psychological components which have triggered the problems.

When I get some time I'll continue on with my recommendations on Age #3, which will include the day-care and pre-school years. It's during this critical period that around 80-90% of our life patterns and habits are established. It's a lot easier to teach good survival patterns during this period if we start with a solid foundation of learning from conception on through the break with mother . . . into when we can use language for communication.

**Babies and Hamming**

What has all this got to do with amateur radio? Why should you care one zot about how babies are brought up? Well, I'm trying to solve a problem and, as in most solutions to problems, it's necessary to go back to some basic roots. My aim is to help improve our American quality of life. That's my most basic goal. It's obvious to me that the more skilled our work force in the next century, the better off we'll be. We see low-skilled jobs being moved to lower wage countries and we know that this is a process that can't be stopped. We can fight it with rhetoric and tariffs, but marketplace competition will eventually win out. You can't keep imports out with tariffs. Look at the hundreds of billions we're spending trying to keep out drugs. And look at the total failure we've had with this approach.

Okay, we need higher skilled workers. This means skills in high-tech businesses and manufacturing. And this means better education and motivation. So I envision our having millions of kids interested in amateur radio as a way to be motivated to learn. We know from our history that if we get kids interested in hamming early on they almost invariably continue on to be technicians, engineers and scientists. In the '50s an ARRL study showed that 80% of all hams who started in their teens went on to high-tech careers.

So my approach is to provide the educational system which will attract youngsters to high-tech hobbies such as amateur radio, computers, electronic experimenting, and so on. And, the more I looked into the educational system, the more I understood how it starts out at conception, not when kids first enter school. So there you are.

We need to make major changes in our Age #3 educational approach. And we also need to make even greater changes in our Age #4 system, which takes us into adolescence. Hey, we'll get all this into shape eventually . . . and when we do, we'll not only be a model for the whole world (again), we'll be the leaders in an incredible world market for our educational products. And that's going to be a trillion-dollar market.


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# Techno Whizzy, Part II

*Continued from page 14*

OK, but more than 0.3 volts means something is wrong. Check the biasing resistors—and is the transistor in backwards? (Mine was.)

Hook the RG174 cable from RF out on the DDS VFO board to the input (J3). Plug a scope into the "hot" end of R5 and apply power to the TW-1 via the J2 on the power supply board. If you're still set to 7040 kHz and channel 12, you should see a nice sine wave at about 0.7 volts peak-to-peak. Hook the scope up to the output at C3 (you should see very little), then key the unit and you should see 4 volts p-p. That's 40 milliwatts, enough power to make a contact by itself. However, we can run a little more than that, so let's do the final amp.

Hook the scope up to the center conductor of the antenna jack and key the unit. You should see a nice sine wave at over 15 volts p-p. Turn switch SW1 off and it will go away. If you don't see this, check the usual suspects—resistors of the wrong value, transistor dead or in backwards, mis-attached transformers, etc.

This amplifier is linear down to about 11 volts, but below that it has a small amount of distortion. To remove this distortion will require a filter between the amp and the antenna. I've included a schematic for a five-pole filter that'll keep your TW-1 FCC legal if you run with a low battery, and a parts list indicating what values of caps and inductors to use. Boards for this are available from FAR Circuits (18N640 Field Court, Dundee IL 60118), and a chart of what components to use for different bands is listed in the sidebar.

If you want to run the TW-1 on all bands with a dying battery, you'll need to switch in different filters. Use a two-pole six-throw switch (available from Radio Shack) to switch different filters in and out.

You're done with the "radio" part now, so let's do the case. Pick a nice case—you'll want to show this off at the club. Make sure there's some extra room inside for a few more boards (for the digital front-panel and receiver boards, at least).

The back of the TW-1 needs a power jack, a fuse, an antenna jack and a reset switch. I usually use an SO-239 or RCA phono jack for the antenna connector, and a panel-mounted fuse holder (so I can change the fuse without dismantling the radio). The power connector needs to handle about 1.5 amps. The reset switch is an SPST NO momentary push-button switch—you'll probably never need it but it's there just in case.

On the front you'll need room for a 12-position rotary switch, the T/R switch, the key jack and perhaps a light to remind you the TW-1 is turned on. Label each position of the switch for which frequency you're using. The key jack can be a 1/4" headphone jack—run your TW-1 from a straight key or a keyer.

Congratulations, you've just done the impossible—built your *own* home-brewed digital radio! Prepare to have fun with your new Direct Digital Synthesized Techno Whizzy model 1 transmitter. Maybe you'll be the first DXCC with QRP DDS!?!

So, what's the next step? How about a digital front-panel with LEDs and a keypad for frequency input to replace the diode array? Or a receiver board to turn the TW-1 into a full transceiver? Or a mod to use the TW-1 as a signal generator with tracking, to turn your oscilloscope into a filter sweeper? Or a mixer to run the TW-1 at 6 meters? How about adding 8K worth of battery-backed-up memories and a CAT (computer assisted transceiver) interface? SSB, anybody? Maybe a 5-watt amplifier stage?

All of these are planned, and the first two are being prototyped already. Watch for them in the next few months. If you have an idea you'd like to add, drop me a line. I can explain what's planned for the 50-pin headers so your device won't interfere with the other boards.

You can write to me at 1307 N. Richmond Rd, Apt H, McHenry IL 60050, or contact me on Usenet at jjw@precipice.chi.il.us or on CompuServe at 70410,1642. 73


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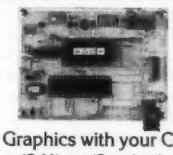

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## Notes from FN42

*It is now the beginning of a new year. What lies before us? Might it be world peace? It is encouraging to hear that some countries that have been having civil wars are now pursuing peaceful means of settling their differences, as in Mozambique as reported by Phil Gray KA7TWQ/C9RPG.*

*We as hams have a chance to exercise our rights to help each other and to help new hams get started in our wonderful hobby. Last year I mentioned that a group of hams in the Keene, New Hampshire, area had provided evening classes for the Novice/Tech licenses. I just finished talking to several of those who participated in the teaching of the classes and they have all enthusiastically volunteered again, even the one who spent many hours coordinating the effort. All we need to do now is set the place and the dates and let the word be known to the local media, packet, local nets, etc.*

*If you feel that you can't do this, or that you will let someone else do it: Before you make that final decision, please read the parable in the news from Australia. Then, think about how it relates to amateur radio and you.*

*GET INVOLVED! 73, Arnie N1BAC.*

### Roundup

**China** *China Ham News, Issue No. 1 from the Tsinghua University Amateur Radio Club, edited by Rick Hunter, Public Relations Manager:* Hello from Beijing! BY1QH is the radio shack located on the 4th floor of a dorm on the campus of Tsinghua University. The campus is located in the northwestern part of Beijing, roughly 10 km from the city center, Tiananmen Square.

The equipment in the shack consists of an ICOM IC-750A, an AEA PK-232 TNC, an IBM 286 computer with a 20 meg. hard drive and monochrome monitor, and a four-element 14 MHz yagi, a three-element 21 MHz yagi, and a vertical. We have an ICOM amplifier that is inoperable at the present due to a bad 2SC2652 (we think). That sort of part is very difficult to locate here so if anyone might have one laying around and would send it to us, we would be extremely grateful.

We were honored to have Mr. William Santelmann N1AU from Massachusetts pay a visit, along with his friend Carl Lehr, on April 10, 1992. Besides having a look around the radio shack, Bill gave a terrific lecture on "The Incredible Ham Radio" to as many as 200 Tsinghua University students. His talk was very warmly welcomed. Bill also kindly presented us with the 1992 *ARRL Radio Amateur Handbook* and a copy of "CT," well-known computer software for contesting logging developed by K1EA.

Mr. Bob Boyd W1VXV from Maine, together with his XYL Carol, had an eyeball QSO with us on September 2, 1992. Unfortunately, we had some problems with our rigs at that time so he couldn't operate, but they had a good time talking with the students on campus. The Boyds previously visited BY1BJ and BY1PK.

BV3AC of Tsinghua University in Taiwan, and BY1QH of Tsinghua University in Beijing took part in the Jamboree-On-The-Air (JOTA) activity in October on 15 and 20 meters. JOTA is an annual event sponsored by the World Scouts Bureau in Geneva. Our special gratitude to Mr. Wang Wenlong BV3AC for his wonderful ideas and information.

BY1QH has just registered at the JA5TX AMTOR/PACTOR mailbox. Because of our limited output power and the recent poor propagation, this might be the only mailbox that is available to us. Feel free to pass messages to us at JA5TX.JPN.AS. *[The path works because I have already passed a message and received a reply passed back by VE7CIZ.—Arnie]*

We are quite new to packet radio, although the interface we are using may enable us to show up in the BBS mode. We badly need to know how to get into a BBS and any information will be appreciated. Is e-Mail available from a BBS?

Our present QSL information listed in the callbook is PO Box 2654, Beijing, People's Republic of China. If you have sent a QSL before but have yet to receive one in return, we would like to mail another, provided you request again. A BT8ØTUA Special Event QSL (voided) will be sent simultaneously as a gift. For faster reply use the address at the end of this file.

The latest figures show that there are 77 amateur radio stations all throughout China at present. BY1QH has the QSL info on 76 of them, which might be of help to you. Don't hesitate to ask if you have no idea where to send the card. An SASE is of course nice to have.

Our thanks go to Bill N1AU, Bob W1VXV, Wang BV3AV, Ted W2FG, Ray NV2A, Don W8OJQ, Jim N2HOS, Joe N4QQ, Wang BY1BJ, and Tong BY1PK for their support and help. In addition, special thanks to JA1AN for sending us *JARL News* magazine, and to our Taiwanese friends who have mailed us their *CQ Amateur Radio* magazine. In particular, thanks to JA5TX for making all this news file possibly known to others.

For further information, or any help that is available, please send messages to me at JA5TX.JPN.AS, or at this address: Rick Hunter, Room 316, Building No. 25, Tsinghua University, Beijing 100084, People's Republic of China.

The BY1QH news may be sent by any means to anyone or any institution without asking for permission. Our sincere appreciation to you for letting others catch up on our news.

*[This information was downloaded from packet. It was downloaded from JA5TX at VE7KIT on PACTOR, then distributed by VE7CIZ, George. VE7KIT is is contact with JA5TX (Mitsou's PACTOR/AMTOR BBS in Kochi) two or three times a day. If you have messages that you would like to send to BY1QH, you can send them to VE7CIZ @ VE7KIT. #VANC.BC.CAN.NA, and he will be glad to pass them on via JA5TX.—Arnie]*

**Philippines** *Sent by Rainier R. Bautista DY9CKQ* **CQ, CQ, CQ . . . OUR RADIO CLUB IS DYING!** The world of amateur radio is expanding in some parts of this planet Earth. Every second, the airwaves are so crowded with so many languages, sharing ideas, jokes, hobbies, experiences and so many other things a human being would like to express. Somewhere, there are hams going on DXpeditions while others are hunting for more and more fellow hams in the air for their DX awards. Others are learning the Morse code and reviewing their theory of simple electronics and radio laws while others are assembling and testing their home-brew radios or perhaps constructing their magnificent and gigantic steel towers decorated with different kinds of antennas . . . yet somewhere in this world, an amateur radio club is dying.

It was 1985 when the Organization of South Cotabato Amateur Radio (OSCAR) was organized in the southernmost part of DU-land, the Philippines. It actually started here in our town, Koronadal or Marbel, but the members were outnumbered by their invited interested parties from Gen. Santos City, which is 57 kilometers away. When the association was registered with the Securities and Exchange Commission, it was addressed to them and they got most of the credit from the Philippine Amateur Radio Association (PARA) and from everywhere else in the world as DX9OSCAR. During those times, the group constructed a repeater station at the foot of Mt. Matutum, but it was not strong enough for a hand-held transceiver to trigger. For more than a year now the repeater station has not functioned due to some technical problems.

There is one president of our club, while there are two people for the rest of the positions, i.e., two vice-presidents, one for the city and one in South Cotabato; likewise for the secretary, treasurer, auditor, and press relations officer. The group has one organizational chart, but on functional aspects it is separated. Here in Koronadal, the station is called OSCAR-MARBEL.

In 1990 I began to have an interest in this hobby so I joined OSCAR-MARBEL because one of the organizers was my father and he had suggested the name of the group. He was not able to continue this expensive hobby because of the examinations. I was an associate member, being the second operator of Dr. Gerte Pingoy DU9EP. Now I have my own callsign, DY9CKQ, as a Class "D." I have just passed the 5 wpm CW and I will be upgraded to DU9CKQ as Class "C" in December. This means I could already operate on HF and my dream of DXing will be realized somewhere in the future.

At my age (21 years old, second youngest member of the group) and as a graduating student in a Norte Dame school, I was nominated and elected this month as 1993's vice president of OSCAR-MARBEL. I "won" because I was the only nominee. Nobody else would dare to handle the responsibility of leading a dying organization. That is why I had to take the role because I saw and felt the importance of amateur radio in our community.

During the first four years of OSCAR-MARBEL's existence the group was very active when it came to communication, fellowship and sportfest, community service (monitoring the peace and order of the town for 24 hours), and they could even garner 40 to 60 stations to check in during the net. In the fifth year, the achievement of the club started to deteriorate and it even ceased its operation twice, for almost eight months between 1989-1990, and for three months in early 1992. Today we can have five to 15 stations join our net even though there are 50-75 hams within the town, not to mention associate members.

Perhaps leading the club at this age is somewhat difficult, but I think it is a good experience and opportunity for me to undertake, Yes, of course, I have my own dream—a dream of having a conversation with a lot of people out there—a dream of having certificates and plaques displayed on the bamboo walls of my small room—a dream of becoming a hamwriter, sharing my experiences and ideas that could contribute to the development and progress of radio amateurism and that could inspire newcomers—a dream which made me move forward and have a deeper interest in this hobby. Yes, I know that it will be a long, long way to go, and I believe that along the way, helping to reactivate my club, my dreams will be achieved.

And the question goes again . . . is our radio club dying? If I have to base my answer on the present situation, "No, it is not. It's just being paralyzed!" But if I have to compare it to the past activity of the club and to the

status of other amateur radio organizations, "YES, OUR RADIO CLUB IS DYING!"

For all of these, I am just wondering if there is anybody out there who could extend their help to the development of our amateur radio club here in the southernmost part of the Philippines? If so, please write to me at the following address: Rainier R. Bautista DY9CKQ, OSCAR-MARBEL, c/o Marbel Peterpan, Koronadal, 9506 South Cotabato, Philippines. *[Does this sound like your club or a club you know? If you can help, do so. It means so much for so many people, especially Rainier.—Arnie]*

**Republic of Slovenia** *Letter from Joseph Zelle W8FAZ. Source: Slovenec, October 22, 1992:* Anton Stipanich, President of the Association of Radio Amateurs of the newly formed Republic of Slovenia called a press conference on October 21. The occasion was the coming worldwide competitions involving some 3.5 million amateurs in 300 countries.

"With the attainment of self-government and independence of the Republic of Slovenia, the Association of Radio Amateurs of Slovenia has likewise arrived where its members will be able to take an active part on the world scene. For on October 24 they will get the new callsigns whose first part, S5, indicates the Republic of Slovenia." *[The information received and published last month was incorrect; 4N3 may be for Croatia.—Arnie]*

It was the Slovenian amateurs who first let the world know what was going on during the brief failed June war last year. In the Bosnia war, Slovenian amateurs have been contacting fellow hams there and getting all kinds of information. Thus the thousands of war refugees in Slovenia are learning about the true situation regarding their relatives back home.

The association is comprised of 89 clubs, including over 300 active members. In the tradition of amateur radio, President Stipanich further pointed out that Slovenian amateurs especially stand out during natural catastrophes and disasters. For example, during the heavy floods last spring hams provided many reports. Beside their contribution in the Slovenian war effort, they also aided the victims of earthquakes in the areas near Slovenia.

Stipanich also saw the worldwide competitions scheduled for October 24 as an excellent opportunity to promote Slovenia throughout the world.

Frank Mocnik KP4AOD of Orlando, Florida, reports that S5 would signify Slovenia. A second numeral would indicate the district. Thus S51, S52, S53, etc. will probably be the new international prefixes replacing the old defunct Yugoslav YU3 callsign.

**Switzerland** *From the International Telecommunication Union Press:* The Asia Telecom 93 Exhibition and Forum will be held in Singapore from 17 to 22 May 1993 under the theme "Telecommunity; The Next Era Of Growth." Hosted by Singapore Telecom and the Telecommunication Authority of Singapore, Asia Telecom '93 is organized by the International Telecommunication Union (ITU) and will take place in Singapore's World Trade Centre, ideally located and offering advanced exhibition and forum facilities.

For additional information, please contact: Ms. Suzan Hee-Sook Lee, Project Manager, Asia Telecom 93, International Telecommunication Union, Place des Nations, CH-1211 Geneva 20, Switzerland. Tel: +41 22 730 5811: Fax: +41 22 740 1013.

**USA** *Note from Stu Stephens K8SJ:* "I will be active as VP2M/K8SJ, Montserrat, British West Indies, February 5-17, 1993: all bands, mostly CW, 20-30 kHz up from the low-band edges. QSL via the 1992-93 *Callbook* address: Stu Stephens K8SJ, PO Box 266, Girard OH 44420. Non-SASE QSLs will be routed through the Bureau. All QSOs will receive a QSL!"

## AUSTRALIA

*David Horsfall VK2KFU*
*PO Box 257*
*Wahroonga NSW 2076*
*Australia*

I have been waiting for further details of the new licence structure in Australia, and by the time you read this, they will have announced it at the SEANET '92 Convention in Darwin, Australia. The announcement itself would have been relayed on the various WIA broadcasts. Apart from the general deregulation of conditions (especially packet radio), Novices are expected to be the main beneficiaries. My next "73 International" column will carry full details.

The VK4 (Queensland) Division of the WIA and the Queensland Department of Education have submitted a joint proposal to the DoTC on using ATV to link classrooms during school hours, when most amateurs are at their jobs. Comments from amateurs were solicited, and this has already upset a few people, who appear to be concerned about the "commercial use of amateur bands." This is an ideal opportunity to expose school children to amateur radio, but naturally it will need to be carefully controlled to ensure that amateur frequencies remain in amateur hands.

A recent High Court decision has upheld the right to "political" free speech, to counter a proposed ban on political advertising. It is worth noting that Australia has no right of "free speech" as such. The relevance to amateur radio is its possible impact on the packet radio network, since sysops (system operators) were free to delete what they thought were obnoxious or illegal bulletins; this is now thought to be in doubt by some.

Finally, it appears to be fashionable amongst the uninformed to "bag" the WIA (Wireless Institute of Australia) for various perceived shortcomings, and I gather Australia is not alone in this respect. Whilst no organization can be 100% perfect, amateurs' interests would be better served by offering constructive criticism and volunteering to help wherever necessary. I leave you with this parable, relayed to me by Richard Murnane VK2SKY, although it may not be original: A man was wandering alone in the mountains, in the middle of winter, and in great danger of freezing to death. Just as darkness was falling he came across the smoldering remains of a tree that had been hit by lightning. He said to the remains of the fire, "I will get you some wood and build you up into a fire, but only if you warm me up first," and lay down next to it. The next morning, the fire was dead. By some odd coincidence, so was the man . . .

Cheers for now. Those with access to Internet or packet can contact me as "dave@esi.COM.AU" (note the new address) and "VK2KFU @ VK2RWI.NSW.AUS.OC" respectively.

## MOZAMBIQUE

*Phil Gray KA7TWQ/C9RPG*
*c/o CARE, C.P. 4657*
*Maputo*
*Mozambique*

Peace at last! Or at least there's a good start. Through the efforts of several western and southern African nations, Mozambican peace talks began in Rome last year. The peace initiative in Angola was also helpful in getting the discussions started. After several months of false starts and more months of various derailments or disappointments, peace was finally signed 3 October 1992. This was good news and a very important first step, but there was no dancing in the streets. The ordinary Mozambican has had so many promises broken and hopes dashed in the past 15 years that he has become a very wary, if not cynical, person. When I arrived here in January 1987, the country was Marxist, destitute, and in the middle of a civil war in its 12th year. But worse, amateur broadcasting was prohibited!! Even so, four hams have been granted limited broadcast permits over the years: an employee of the Swedish Embassy, a German tourist, and the traveling Colvins. But the efforts of the rest of us finally paid off last year when the government legalized amateur radio and opened an official radio club in May 1991. Since then we have been on the air in fits and starts with an American, Steve Marshall C9RSM, the most frequent user. There may be a total of seven of us, two of whom have stations at home. After I installed the SatelLife ground station at the university medical school in December 1991, I was on OSCAR 14 until February when amateurs were moved to OSCAR 22.

The urban economic situation began to improve as Russia underwent its changes three years ago, but conditions in the rural regions remained the same—or worsened—as the war continued.

So what now? Elections are to be held within 12 months and I have seen campaign posters up already—a positive sign. The countryside needs to be rid of marauders, thugs, and gangs that prey on villagers and farmers. This will take perhaps five years alone, maybe 10. The roads and railways need to be rehabilitated so goods and people can move within the country and exports/imports can cross its borders. South Africa and Swaziland are 50 miles away from the capital, Maputo, but we cannot go due to bandit or rebel attacks. We look forward to a safe drive before I leave in June—just to say we've done it.

With a coastline the length of California's, there also is (and was) tourism capability. That, too, needs to be rebuilt and staff trained. And speaking of training, most of the schools in the country have been severely damaged and books lost, stolen, or destroyed. Same or worse for the hospitals.

So we're at a critical point in the nation's history and development, but at least and at last amateur radio is back on the air. Listen for us on the weekends.

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*San Diego Microwave Group*
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*San Diego CA 92119*

### MMIC Amplifiers

This month I will cover MMIC amplifiers. A few questions have popped up from our readers covering surplus MMICs and how to identify them. I will focus on surplus MMICs that I have obtained, describing how to identify them. There is no problem in component identification for those who purchase exactly what they desire, but what about those of us who scrounge components and MMICs from surplus PC boards? How do you recognize and identify them?

I will also cover the pinout information for the most popular MMIC amplifiers. This can be confusing—in my own scrounging I recognized that a different series of markings was used to identify each component but I didn't realize just how far this marking scheme went. Identification of devices from several manufacturers or even between devices from the same manufacturer on surplus PC boards was, at the beginning, not easy. The further I explored this the easier it became, and I am sure it will be easy for you as well.

What I got into in my trip through the junkyard surplus dealers were component parts labeled A-06, A-01 (letter-number), and 414 (totally numerical). Other devices had dots of various colors on top of the plastic case of what I believed to be MMICs. These were the devices that partially populated the surplus PC boards of interest to me. The problem with these miniature components and corresponding miniature part numbers is one of identification. You must realize that this numbering scheme is not limited to just MMIC amplifiers but can cover transistors, GaAsFETs and other devices. Some of these packages can have very small case dimensions with correspondingly small identification markings because there's not much room for large part numbers.

For instance, GaAsFETs seem to be identified with a two-letter code like Af, Be, Hj, etc. I have not yet broken this code for the GaAsFETs, but I believe these devices are manufactured by Fujitsu. Better luck prevailed with the MMIC amplifiers—I was able to decode their part numbers.

The MMIC amplifiers that I obtained on the PC boards were quite easy to decode once I figured out that the manufacturers were Avantek and Mini-Circuits Labs. Determining the manufacturer of the devices helped considerably in identifying their components, giving away further clues on how their component parts were labeled. The main problem lies in the fact that these are miniature components and cannot contain a full part number. They have just a partial number and this must be used to recognize them. This isn't tough but it can be intimidating until you recognize the format. To become familiar with these part numbers you must browse through parts manuals in your field of interest to pick up subtle facts and store them in your memory for recall.

#### Avantek Parts

First, let's discuss a little about device package styles. Devices are available in a variety of case styles from leadless chips to high quality ceramic to low cost plastic packages. This case style in some instances takes into account the physical dimensions of the package, like the MSA-0685: The MSA-06 specifies the type of device; the "85" calls out a 0.085-inch plastic package. The various Avantek part numbers all have this simple format in common—the last two digits represent the case style. Until I understood this I was trying to keep a larger part number straight in my head and I was not having much luck trying to figure out that an MSA-0385 and an MSA-0386 were not too different at all, just case styles. I guess I got stuck on the old 2NXXXX and 1NXXX numbering schemes. Once I got this straight, it cleared up a lot in the MMIC amplifiers for me. See Table 1 for other package types.

There are still a few quirks in the labeling of devices but let's cover them one at a time. Avantek devices, both transistors and FETs, have a similar base part number. Transistors begin with the prefix "AT" and FETs begin with "ATF." Only the three-digit number following each is different. The last two digits reflect case style. In the case of MMIC amplifiers, the part number begins with MSA and has a four-digit part number: The first two identify the part while the last two identify the case.

MMIC amplifiers can be supplied from the two different major suppliers, Avantek and Mini-Circuits Labs, but be careful—they are identical in specifications but differ in device orientation. The Avantek part is keyed on the output of the device with a dot or triangle imprinted or a dot depressed in the case, denoting output. The device number, such as "A-06," is also imprinted on the top.

#### The Mini-Circuits MMIC

The Mini-Circuits MMIC is printed with a color-coded dot on the input, opposite the Avantek orientation. Don't ask me why but that's the way it is. I suppose that Mini-Circuits wanted to differentiate the MMIC amplifier they sell from Avantek's. Just be careful to note which device you are working with. They do use different marking indicators so it's easy to tell them apart.

#### Surplus MMICs

What started all this was some surplus printed circuit boards that our group picked up. From the first, I thought all the devices on the PC board were MMIC amplifiers. However, once I consolidated the component markings with some common sense and a few catalogs, the identification process came together. Some of the devices I was able to scrounge off of these PC boards were the MSA-01, -02, -03 and -06 devices, all MMICs. The transistors were part number AT-414 and AT-420 devices.

The -01 devices are rated to 1,000 MHz while the -02 and -03 devices are rated to 2,000 MHz. Power gain runs from the 13 to 18 dB gain at 100 MHz to 12 dB at 1,000 MHz and 10 dB gain at 2,000 MHz. The noise figure runs in the 5 to 7 dB range with the -01 device having the 5 dB noise figure. The maximum power output for these devices runs from 0 dBm for the -01, to +3 dBm for the -02, and +8 dBm for the -03 device.

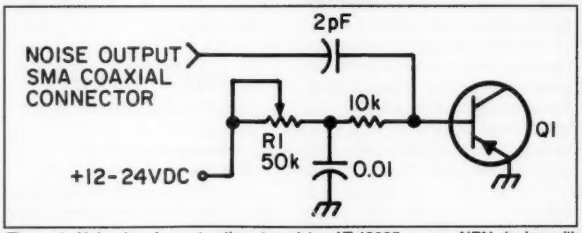


*Figure 1. Noise head construction: transistor AT-42085 or any NPN device with high Ft. Set R1 for 1-2 mA current through the Q1 base emitter.*

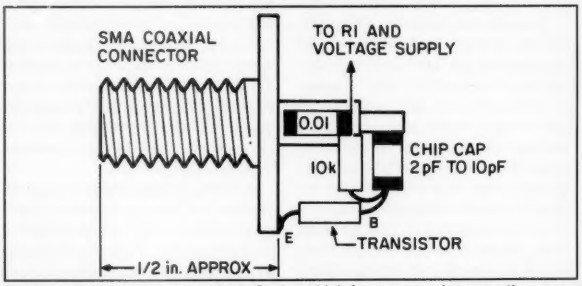


*Figure 2. Parts placement method. For best high frequency noise operation, use a chip capacitor to couple the SMA pin, using the shortest possible lead lengths from the capacitor to the base and emitter to the ground.*

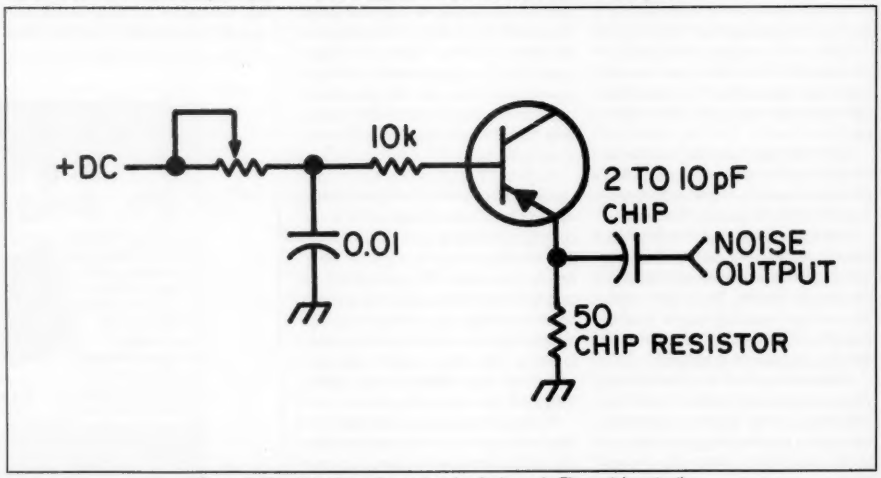


*Figure 3. Possible alternative to the circuit shown in Figure 1 (see text).*

# DAYTON Hamvention® '93

**April 23, 24 & 25, 1993**

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Advance Registration and Banquet:
USA - April 2 Canada - March 26
Flea Market Space: February 1

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I was pleasantly surprised to find that the -06 device (actually an MSA-0685) has 20 dB gain at 100 MHz and 11 dB gain at 2,000 MHz. The noise figure is 2.8 dB. Not bad for a broadband device, even with the output power limited to zero dBm. You just can't have high power and a low noise figure at the same time, with low cost. In any case, this -06 device should be quite good for general purpose amplifiers in low noise applications. Even at a 2.8 dB noise figure this should be quite suitable for many older radios serving as a broadband preamplifier. See my column in the April 1992 issue of *73* for other MMIC specifications for Mini-Circuit MMIC devices.

The A-414 and A-420 devices scrounged from the PC boards are bipolar transistors good to 6 GHz. The 414 device (AT-414) has a noise figure of 1.7 dB at 2 GHz and a device gain of 13 dB at 2 GHz. The 420 device (AT-420) is a little more husky, giving +20 dBm output power (that's 100 mW), a gain of 13 dB, and a noise figure of 1.9 dBb, all at 2 GHz. Quite a device, especially from the junk box. One surprise is that I use the Avantek AT-42086 transistor normally and don't know why I did not recognize it at first. My devices came in a tape reel and were upside down—that must have prevented me from associating them because of their orientation in the tape reel (at least that's the excuse I am using).

**RF Noise Source/Generator**

These 420 devices have been the mainstay for pet microwave projects in my shack for some time. I have used them for so many different projects and applications even I can't keep track of all of them. The most interesting and simple application that I used them for was a noise generator. This unit works from a low frequency of a few MHz up into the GHz range. The circuitry is quite simple and only requires a current-limiting resistor and chip capacitor for coupling. Only two leads of the transistor are used—the base emitter junction. The collector is left open.

The principle is that with forward current flowing through a junction, noise will be generated up to the "Frequency Total," or Ft, of the device. Since these devices are rated to 6 GHz they worked quite well into the several GHz range. This little project can be used to drive MMIC amplifiers to increase the power output. Why, you say? Well, noise generators can drive bandpass circuits with sufficient power and the output can be observed being indicative of its frequency response. This shaped noise can be displayed on a spectrum analyzer depicting bandpass vs. frequency. (A sweeper is not needed.) The noise generator and MMICs can complement one another.

The power supply is the only complicated thing in this entire project. It can be as simple as a 9-volt battery and regulator which will provide noise output whenever it is switched (turned on). A more complicated unit would be composed of a power supply/battery that could be pulsed on and off at a set rate. This pulsing power supply is what really makes the noise source perform and is the most common method of operation. A noise figure test set normally provides all power supply functions for the noise head, as well as displaying the measured noise figure directly in dB. The test set additionally has circuitry to do all the computations to give you a display or readout of the actual noise figure.

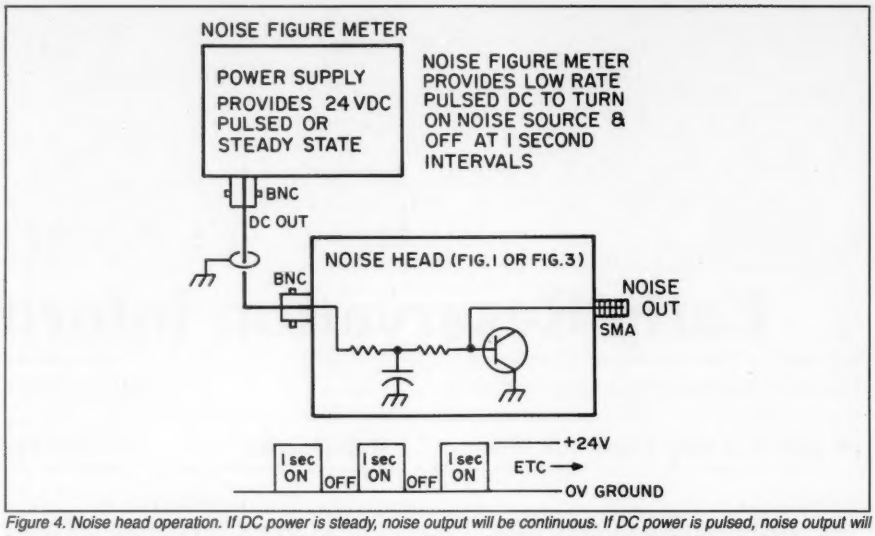



*Figure 4. Noise head operation. If DC power is steady, noise output will be continuous. If DC power is pulsed, noise output will be pulsed. A pulsed noise source is useful to determine the difference between noise to no noise for the noise figure ratio.*

A simple noise source similar to the one described this month for steady-state noise will work just as well without all the calibration accuracies of a conventional full-scale noise figure meter. All you have to do is read the difference in output of your receiver (noise source on and then off) and determine from the ratio of noise-to-no-noise just what your noise figure is. It's not complicated to figure out your noise figure, but you need not go through the math. With a noise source instead of a signal generator, tune your system for best noise performance and you're done. True, you don't know exactly how well it's working but it will perform better than if you tune it up with a signal generator.

In actual practice, it's easy to peak up your system's performance by using such a simple noise generator. Just adjust your preamp and RF stages in a receiver for maximum noise as detected on the output of your receiver. Don't start from scratch to do noise alignment this way—as stated before, your receiver must be operational first. The noise alignment method is used to peak or maximize the best performance, not to do a total alignment of a radio. See Figure 1 for the construction details of a simple AT-42086 noise generator RF head. It should be constructed with minimum lead length as the longer the lead length the lower the maximum frequency of operation will be.

To minimize lead length I chose to construct the noise generator on the back of a miniature coaxial connector, an SMA type chassis connector. This connector is made to work with coaxial cable (solid shield 0.141-inch diameter) that is quite small in diameter. It is intended primarily for microwave operation and is good to 18 GHz. In our application, small is better as this helps to keep lead length to a minimum. This improved high frequency operation (in the GHz).

In normal operation a special noise diode is employed to do the function of generating noise. In our application we are replacing the diode with a a base-to-emitter junction of a microwave transistor as they work quite well and cost a lot less. The circuit for the noise generator is quite simple and uses few parts. See Figure 2 for the component configuration to minimize on lead length. The basic circuit uses four parts: a coaxial connector, a chip capacitor, a chip resistor and the microwave transistor. To use the circuit, provide a source of DC power positive to the base of the transistor through a current-limiting resistor set to draw about 1 mA of current to start with. This resistor value will vary depending on your transistor. Normally, you should start with a high value resistance, say 50k ohms, and adjust lower until you read 1 mA of current. Maximum current should be no higher than a few milliamperes. I use a 24-volt power supply with two 10k resistors in series with my transistor and draw 2 milliamperes of current. The second 10k resistor originally was a pot for best adjustment but it works well with the fixed resistor for miniature size.

Figure 3 shows a modified circuit for better high frequency response. I haven't experimented with this circuit yet but it might be interesting to try. It is supposed to provide higher frequency noise output than Figure 2 by lifting the diode anode end (our emitter) from ground and terminating it in 50 ohms. The RF output is directly fed from this point. I prefer the first circuit (Figure 2) for DC isolation and simplicity reasons. The transistor used in either circuit is the Avantek AT-42085, which has a frequency rating good to 6 GHz. If you can't locate a device, I will provide a kit of parts including several Avantek transistors and the resistors and a chip capacitor. You will have to come up with your own coaxial connector. By the way, the SMA connector is not the only one that can be used; even a type "N" is suitable—it's larger but works quite well. Cost of the parts kit is $7 postpaid. (Note that any microwave npn device will work in this circuit; it's the high frequency junction, base to emitter, that gets the job done here).

Well, that's it for this month. next month I plan to cover packaged mixers in general. As always I will be glad to answer questions concerning this and similar topics. Please include an SASE for a prompt response. 73 Chuck WB6IGP.

| | | |
|---|---|---|
| 00 | Chip only | Bare chip only |
| 04 | 0.145 plastic | Low-cost plastic pk. |
| 10 | 100 mil. | Hermetically-sealed hi-rel. pk. |
| 11 | SOT-143 | Surface mount SOT-143 pk. |
| 35 | Micro-X | Moderate-cost microstrip |
| 36 | Micro-X | Cost effective microstrip |
| 50 | 50 mil. | Hermetically-sealed hi-rel. pk. |
| 70 | 70 mil. | Hermetically-sealed hi-rel. pk. |
| 84 | 0.085 plastic | Low-cost plastic pk. |
| 85 | 0.085 plastic | Low-cost plastic pk. |
| 86 | 0.086 plastic | Low-cost surface mount pk. |

*Table 1. Package types and case styles (last two digits only) of Avantek devices.*

# UPDATES

Number 25 on your Feedback card

### Packet on the Mac (Update on last month's Update . . . the saga continues.)

Refer to the above article on page 8 of the October 1992 issue. Although the update of the parts placement diagram (see Figure 2 in the December '92 *Updates* section) now has the correct hookup points (shown in blue instead of red as indicated in the caption), the parts placement overlay is incorrect due to a printing error. The parts placement overlay was inadvertantly shifted down in last month's diagram. See Figure 1 in this column for the correct (and hopefully final) parts placement diagram.

### Baby Loopy

Refer to the above article on page 34 of the October 1992 issue. The formula that reads

$$\frac{19 \text{ turns } (3.14)^2}{12 \text{ inches/ft.}} = 9.94 \text{ feet}$$ should read as

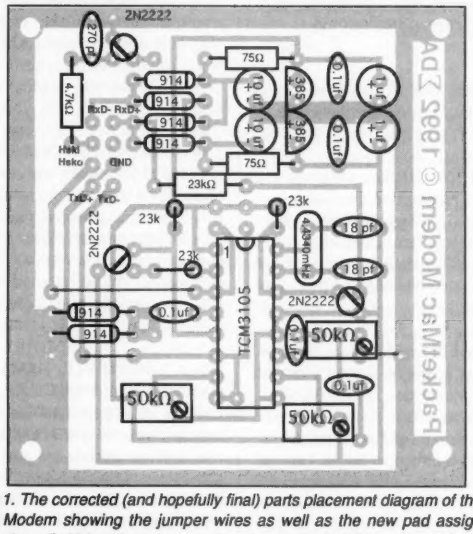
$$\frac{19 \text{ turns } (3.14)\,2}{12 \text{ inches/ft.}} = 9.94 \text{ feet.}$$ The value of 2 is the coil diameter in inches.

### A 2 Meter FET Amplifier for Your Handheld

Refer to the above article on page 20 of the October 1992 issue. The schematic diagram and the parts list shows the value for RFC1 and RFC2 reversed. RFC1 should be 20 turns of #16 wire, 0.3 inch diameter. RFC2 should be a 100 µH choke.

The following changes to improve the amplifier's performance have been sent in by the author: The diodes on the output (D5 and D6) get hot; putting two other diodes in parallel with D5 and D6 will solve this problem and increase the power output. Communications Concepts, Inc. is a source of many of the parts for this amplifier. You can reach them at 508 Millstone Dr., Xenia, OH 45385; Tel: (513) 426-8600. For C1 and C12, use an ARCO 406; For C2 and C4, use an ARCO 403 and 404 respectively. C3 calls for a 56 pF Unelco capacitor and C5 uses a 680 pF chip cap. Adding C13 (0.01 uF chip capacitor) in parallel with C8 appears to improve the amplifier's performance. RFC2 can be replaced with a Ferroxcube VK-200–10/4B choke.

If you still cannot get the rated power out of the amplifier, try putting a 144 MHz signal into it. Adjust the timmer capacitors and R3 for maximum output and record it. Then send a 148 MHz signal into the amplifier and repeat the procedure. If you get more power out at 148 MHz, then the amplifier is resonant above the 2 meter band. Try replacing L1 and L3 (or both) with coils that are a quarter-turn longer than the original ones. Keep experimenting until maximum power is obtained. Conversely, if you have more power output on 144 MHz, then you should shorten one of more of the above coils.


2N2222
270Ω
75Ω
914
914
914
914
4.7kΩ
RxD- RxD+
Hsk
Hsko
GND
75Ω
23kΩ
TxD+ TxD-
23k
23k
2N2222
23k
4.4336mHz
18 pf
18 pf
2N2222
914
914
0.1uf
TCM3105
50kΩ
50kΩ
0.1uf
50kΩ
0.1uf
0.1uf
0.1uf

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20N103 **Electronic Power Supply Handbook** *by Ian R. Sinclair* covers many types of supplies—batteries. simple AC supplies. switch mode supplies and inverters. All types of supplies used for electronics purposes are covered in detail, starting with cells and batteries and extending by way of rectified supplies and linear stabilizers to modern switch-mode systems. IC switch-mode regulators, DC-DC converters and inverters. 144 pp., 90 line drawings. **$16.25**

20N104 **Electronic Test Equipment Handbook** *by Steve Money* is a guide to electronic test equipment for the engineer, technician, student and home enthusiast. Provides a practical guide to widely used electronics instruments and the techniques of measuring a wide range of parameters in electronics systems. 216 pp., 123 line drawings. **$18.00**

20N105 **Digital Logic Gates and Flip-Flops** *by Ian R. Sinclair*. what they do and how to use them. Seeks to establish a firm foundation in digital electronics by treating the topics of gates and flip-flops thoroughly and from the beginning. For the user who wants to design and troubleshoot digital circuitry with considerably more understanding of principles than the constructor, and who wants to know more than a few rules of thumb about digital circuits. 204 pp., 168 line drawings. **$18.00**

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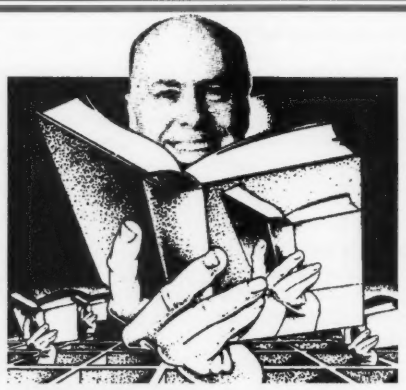

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07R20 **A Radio Journal 1912-1940** *by Russ Rennaker W9CRC* A fascinating trip through time. Easy to read and informative. educational and entertaining. A trip down memory lane to the early days of radio. **$7.95**

11RF13 **The "Top Secret" Registry of US Government Radio Frequencies (7th Ed.)** *by Tom Kneitel K2AES* This scanner directory has become the standard reference source for frequency and other important information relating to the communications of federal agencies. 25 to 470 MHz. **$19.95**

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11SR97 **National Directory of Survival Radio Frequencies** *by Tom Kneitel K2AES* Handy and concise reference guide to high interest communications frequencies required by survivalists. Includes chapter on building emergency communications antenna systems. **$8.95**

11SM11 **Scanner Modification Handbook, Vol. 1** *by Bill Creek* provides straightforward step-by-step instructions for expanding the operating capabilities of VHF scanners. Filled with interesting text, helpful photos, tables, and figures. **$17.95**

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11T89 **Scanner Modification Handbook Vol. 2** *by Bill Creek* Here it is—a companion to Vol. 1. In fact, Vol. 2 has a section that provides improved approaches and updated techniques for the mods in Vol. 1. There's 18 new, exciting modifications for popular scanners and it is fully illustrated with photos and schematics. highly detailed step-by-step instructions so that the average hobbyist can do these performance enhancing modifications. This is an all new book that has all new mods. **$17.95**

03R01 **World Press Services Frequencies (RTTY) New 5th Ed.** A comprehensive manual covering radioteletype news monitoring—contains all information—antenna. receiving, terminal units, plus three extensive frequency lists. Covers 65 World Press Services broadcasting in English. "The Original Press Book." 84 pp. **$8.95**

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AR2626 **Companion Software for Antenna Compendium Vol. 2** 5 1/4" MS-DOS floppy. **$10.00**

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AR0437 **ARRL Repeater Directory 1992-1993** Over 19,000 listings with digipeaters, bandplans, CTCSS (PL(TM)) tone chart, compilation of frequency coordinators. ARRL special service clubs, and beacon listings from 14 MHz to 24GHz. **$6.00**

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AR1250 **Log Book**—Spiral **$3.50**

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AR2197 **ARRL Data Book** Valuable aid to the RF design engineer, technician, radio amateur, and experimenter. Commonly used tables, charts, and those hard-to-remember formulas. **$12.00**

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AR0410 **Yagi Antenna Design** Originally published as a series in *Ham Radio*, polished and expanded by Dr. Lawson. **$15.00**

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AR3185 **The Satellite Experimenter's Handbook, (2nd Ed.)** *by Martin Davidoff K2UBC* Expanded and revised, this 2nd edition of "The Satellite Experimenter's Handbook" is your guide to using and designing satellites, focusing on those built by and for the international radio amateur community. **$20.00**

AR0477 **Low Band Dxing** How to meet the challenges of the different forms of 160, 80, and 40 meter propagation with effective antennas, equipment, and operating strategies. **$10.00**

AR2456 **FCC Rule Book (8th Ed.)** A must for every active radio amateur. **$9.00**

AR2030 **Your Gateway to Packet Radio (2nd Ed.)** Tells everything you need to know about this popular new mode: how to get started, equipment you need, and more. **$12.00**

AR2103 **Satellite Anthology** The latest information on OSCARs 9 through 13 as well as the RS satellites. Information on the use of digital modes, tracking antennas, RUDAK, microcomputer, and more! **$5.00**

AR2898 **Space Almanac** *by Anthony R. Curtis K3KXK* Captures the breathtaking recent news from space. Includes information on Amateur Radio satellites. Find almost everything about man's trip to the stars. 960 pp. **$20.00**

AR2083 **Complete DX'er (2nd Ed.)** *by Bob Locker W9KNI* Learn how to hunt DX and obtain hard-to-get QSL cards. **$12.00**

AR2065 **ARRL Antenna Book** The new 16th Edition represents the best and most highly regarded information on antenna fundamentals, transmission lines, design, and construction of wire antennas. Over 700 pages, over 900 figures. An ARRL Publication. **$20.00**

AR3293 **Morse Code: The Essential Language** *by L. Peter Carron Jr. W3DXV* has been expanded and revised in its 2nd edition. Peter Carron details its fascinating history as well as sharing practical learning information. Readers will learn how to handle distress calls heard not only on the hambands but on maritime and aircraft frequencies. Copyright 1991, softcover. An ARRL Publication. **$6.00**

# CODE TAPES

*One answer to the no-code brou-ha-ha is to make the code so simple to learn that it's a non-problem. Herewith the world's easiest code course—tens of thousands of hams have gotten their licenses this amazing new shortcut way. It's failure-proof. Most people are able to whip through the Novice test after spending less than three hours each on Genesis and The Stickler. People who have given up on other code courses find this one does the job in a jiffy. Going after your General? It's about time. Use the Back Breaker and you'll be there before you know it. A week should do it. Warning: 20 wpm code almost invariably appears to cause irreparable, irreversible, permanent brain damage. Uncle Wayne accepts no responsibility whatever for anything that happens to those who are foolish enough to use the Courageous 20 wpm tape.*

73T05 **"Genesis"** $5.95
**5 wpm**—This beginning tape, takes you through the 26 letters, 10 numbers, and necessary punctuation, complete with practice every step of the way. The ease of learning gives confidence even to the faint of heart.

73T06 **"The Stickler"** $5.95
**6+ wpm**—This is the practice tape for those who survived the 5 wpm tape, and it's also the tape for the Novice and Technician licenses. It is comprised of one solid hour of code. Characters are set at 13 wpm and spaced at 5 wpm. Code groups are entirely random characters sent in groups of five—definitely not memorizable!

73T13 **"Back Breaker"** $5.95
**13+ wpm**—Code groups again, at a brisk 13+ wpm so you'll be really at ease when you sit down in front of a steely-eyed volunteer examiner who starts sending you plain language code at only 13 per. You'll need this extra margin to overcome the sheer panic universal in most test situations. You've come this far, so don't get code shy now!

73T20 **"Courageous"** $5.95
**20+ wpm**—Congratulations! Okay, the challenge of code is what's gotten you this far, so don't quit now. Go for the extra class license. We send the code faster than 20 per. It's like wearing lead weights on your feet when you run: You'll wonder why the examiner is sending so slowly!

# ANTENNAS

20N108 **The Easy Wire Antenna Handbook** *by Dave Ingram K4TWJ* Get out your roll of wire and your wire cutters, you are ready to go with this new practical and easy to understand book. Gives you all of the needed dimensions for a full range of easy to build and erect "sky wires." Covers all of the many types of wire antennas along with a lot of his antenna secrets and "how-to-do" helps. **$9.50**

05A95 **Easy-up Antennas for Radio Listeners and Hams** *by Edward M. Noll* Like to learn how to construct low-cost, easy-to-erect antennas? *Easy-up Antennas* will help you. **$16.50**

01A70 **Practical Antenna Handbook** *by Joseph J. Carr* Design, build, modify, and install your own antennas. Carr, a 20-year veteran of technical writing, has a unique ability to present complex technical concepts in an easy-to-understand way. 416 pp. **$21.50**

# UHF/VHF/PACKET

09V11 **The Basic Guide to VHF/UHF Ham Radio** *by Edward M. Noll* This book provides a first rate introduction to life on the 2.6 and 1.25 meter bands as well as 23, 33, and 70cm. **$6.50**

01P22-2 **The Packet Radio Handbook (2nd Ed.)** *by Jonathan L. Mayo KR3T* "...an excellent piece of work. Well worth reading for both the experienced and the new packeteer...the definitive guide to amateur packet operation."—Gwyn Reedy WIBEL **Only $15.00**

20N019 **U.S. Repeater Mapbook** *by William Smith NoMQS* The Guide for traveling radio amateurs gives you repeater frequencies, and locations on easy to read state map. Includes all 50 states, and 28—1200 MHz. **$9.95**

# BOOKS FOR BEGINNERS

20N018 **Technician Class License Manual: New No-Code** *by Gordon West* This book will cover everything you need to become a Technician Class Ham. Every exact question and answer on the examinations is found in this one book covering element 2 and element 3A question pools. Gordon West tells you the right answer and then explains in detail why the answer is correct. Fully illustrated text, frequency chart showing privileges, list of examiners and an FCC Form 610 application. **$9.95**

20N092 **The Wonderful World of Ham Radio** *by Richard Skolnik, KB4LCS* This book addresses the plea that something simple, clear, and fun be written to introduce young people to amateur radio. Pick one up for the new ham in your life. **$7.95**

20N100 **Electronics Build and Learn (2nd Ed.)** *by RA Penfold* combines theory and practice so that you can "learn by doing." Full construction details of a circuit demonstrator unit that is used in subsequent chapters to introduce common electronic components. Describes how these components are built up into useful circuits, oscillators, multivibrators, bistables, and logic circuits. 128 pp., 18 photos, 72 line drawings. **$12.50**

20N099 **Digital Electronics Projects for Beginners** *by Owen Bishop* contains 12 digital electronics projects suitable for the beginner to build with the minimum of equipment. 128 pp., 56 line drawings. **$12.50**

AR2073 **Novice Antenna Notebook** A beginners guide to easy and effective antennas and tuners you can build. **$9.50** An ARRL Publication.

AR2871 **W1FB's Help for New Hams** *by Doug DeMaw W1FB* Complete for the newcomer. Put together a station and get on the air. **$10.00** An ARRL Publication.

AR2286 **First Steps in Radio** *by Doug DeMaw W1FB* Series of *QST* articles. See components assembled into practical circuits and how the circuits make up your radio gear. **$5.00** An ARRL Publication.

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# RANDOM OUTPUT

*David Cassidy N1GPH*

## Resolutions

It's resolution time again. That once-a-year chance for us to wipe the slate a little cleaner, and try to improve a few areas of our lives. Many people vow to eat less (a good idea) or quit smoking (a great idea) or to spend more time with their families (not a bad idea, either). We hams might promise ourselves to finally get a packet station set up or put up that tower we've always wanted, participate in more public service activities or perhaps introduce someone to amateur radio.

Organizations, too, might find it beneficial to take an annual look-see at themselves and maybe fix a few of the problems that sneak into any organization. Since I'm sure no one down in Newington has done this kind of activity in quite some time (decades . . . about seven-and-a-half of them), I want to show my undying support for our national amateur radio society by offering some New Year's Resolutions for the ARRL. OK boys, repeat after me . . .

"We, the board, officers and representatives of the ARRL, resolve to remember that the prosperity of the amateur radio service is our goal, and that by ensuring the future of amateur radio we ensure the future of the ARRL . . . not the other way around.

"We, the board, officers and representatives of the ARRL, resolve to remember that the majority of amateur radio operators in this country are not members of our esteemed organization. We should also keep in mind that the figures from the last year or so indicate that new licensees are staying away from The League by the bucketful. Perhaps we should learn something from these two facts.

"We, the board, officers and representatives of the ARRL, resolve to attract and make room in our hobby and organization for individuals who are other than middle-aged, white, blue-collar, male, contesters, DXers and traffic handlers. Maybe our ranks would actually be enhanced by seeking out and welcoming those of other sexes, races, ages and operating modes.

"We, the board, officers and representatives of the ARRL, resolve to remember that it is other people's money that keeps us in business, and that we have a responsibility to spend it as wisely as possible. We also promise to give our members a full and honest accounting this year of exactly where the money goes, without hiding expenditures in unidentifiable line items.

"We, the board, officers and representatives of the ARRL, resolve to stop taking full credit for anything and everything that happens in amateur radio. The amateur radio population usually knows the truth about who is responsible for spearheading new rules, technologies, etc., and we just look foolish when we always make it appear as if everything good was a League idea.

"We, the board, officers and representatives of the ARRL, resolve to spend a little bit of the money and investments we have stashed away to actually help fix some of the problems in amateur radio. Money spent on a national amateur radio ad campaign (*not* an ARRL ad campaign)—including television spots on Saturday morning and prime-time TV, educational materials with some relevance to today's youth (Archie is hardly a character that today's youngsters know or care about) and with an aggressive distribution effort—would be money well spent, and would come back to The League in increased numbers and increased revenues.

"We, the board, officers and representatives of the ARRL, resolve to remember the well-known truth that competition is good for business. We are not the only magazine publisher, book publisher, contest organizer or representative body in amateur radio. Acting like we are only makes us look out of touch.

"We, the board, officers and representatives of the ARRL, resolve to take a leadership role in attracting young people to our hobby, no matter how much the old white men we represent hate it. Making money and materials available to schools who no longer have room in their budgets for radio clubs would be a nice start.

"We, the board, officers and representatives of the ARRL, resolve to realize that the future of our hobby—and therefore the very existence of the ARRL—does not lie in a bunch of retired CW operators banging birthday greetings back and forth to each other. Our future lies in (and our support should be aimed at) packet, satellites, spread spectrum, UHF, microwaves, digital synthesis, computer control and the like. Exchanging signal reports and contest numbers may be fun for a weekend every now and then, but it isn't where the future of amateur radio lies (if there *is* a future).

"We, the board, officers and representatives of the ARRL, resolve to live up to our own motto—of, by and for the radio amateur—instead of the apparent attitude we so often display—of, by and for the ARRL.

"We, the board, officers and representatives of the ARRL, resolve to work *with* the FCC in securing benefits for radio amateurs. Lawsuits only make us more enemies in a federal agency where we have precious few friends.

"We, the board, officers and representatives of the ARRL, resolve to take responsibility for the legal and fair operation of the on-the-air events we sponsor. Even though our contests are popular, the vast majority of U.S. and foreign hams do not wish to participate. We should show them a little courtesy.

"We, the board, officers and representatives of the ARRL, resolve to insist that the operators of our station, W1AW, adhere to the same rules that all other radio amateurs are subject to, including checking if a frequency is in use before transmitting.

"We, the board, officers and representatives of the ARRL, resolve to stop trying to take over the complete administration of the amateur radio hobby. Our energies should be spent trying to improve our members' enjoyment and freedom, instead of trying to gain exclusive control of things like callsign allocation.

"We, the board, officers and representatives of the ARRL, resolve to develop a sense of humor and realize that if we're going to bill ourselves as *the* American amateur radio organization, we have to be willing to take a little heat now and then." 73

Number 28 on your Feedback card

# PROPAGATION

*Jim Gray W1XU*

*Jim Gray W1XU*
*210 Chateau Circle*
*Payson AZ 85541*

There's no question about declining solar activity, but each month brings its own bright spots in spite of band conditions. DX is still plentiful, but a bit harder to work these days, and requires better operating skills as well as better antennas.

You will find January with its short days similar to December—but gradually improving. Noise levels are down and the bands from 160 through 30 meters are very active during the evening and early morning hours. Twenty meters to 10 meters is notable for the "early" band closing, shortly after dark or even sooner . . . and on some days very little activity. Therefore, using the charts and tables will be even more helpful to you to pick the best times to work DX.

The "Poor" days (P) are likely to be surrounding the 4th, 8th, 15th and 25th of January, as shown in the daily forecast. You can expect a day or two on either side of these dates as being doubtful (F-P) with conditions gradually returning to normal (G) within another day or two.

For those who may be interested in other geophysical effects, look for winter storms or other activity of consequence—particularly surrounding the 8th of the month when multiple alignments occur, and on the 4th, when there will be a Venus-Saturn alignment. Again, there will be a day or two on either side as planets come into positions of alignment and pass through them.

### Synopsis

10-12m: Fair-to-good daytime conditions during most days WITH MORNING OPENINGS TO EUROPE, AFTERNOON OPENINGS ON NORTH-SOUTH PATHS AND LATE AFTERNOON OPENINGS TO ASIA AND THE PACIFIC. Short skip 1,000-200 miles during the day.

15-17m: Worldwide DX during daylight hours, with openings pretty much as shown for 10-12 meters. DX follows the sun. Short skip during the day the same as 10-12m.

20m: Excellent daytime conditions on most days. WORLDWIDE DX possible with short skip beyond 500 miles and good coast-to-coast propagation within the USA.

30m: DX into Europe in the afternoon and into the Pacific during the early morning hours. Long-path propagation available on many days. This band shares some of 20 meter's characteristics and much of the 40 meter band's behavior.

40-80-160m: These are the nighttime DX bands. You can expect 40 to be your *best* DX band from late afternoon to early morning. 80 meters will peak for DX around midnight local time, and 160 meters will be best during early morning hours and just before dawn. Short skip NOT possible during daylight on 160, but will be okay on 80 and 40 from about 500 miles or so during days and longer during evening hours, out to about 2,000 miles.

Let me know how these forecasts work for you. Feedback is critical. See you next month. 73

**EASTERN UNITED STATES TO:**

| GMT: | 00 | 02 | 04 | 06 | 08 | 10 | 12 | 14 | 16 | 18 | 20 | 22 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ALASKA | 15 | 20 | - | - | - | - | 20 | 20 | - | - | - | 15 |
| ARGENTINA | 20 | 40 | 40 | 40 | - | - | 20 | 15 | 15 | 10 | 10 | 15 |
| AUSTRALIA | 15 | 20 | 20 | - | 40 | 40 | 40 | - | - | 20 | 20 | 15 |
| CANAL ZONE | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 15 | 10 | 10 | 15 | 15 |
| ENGLAND | 40 | 40 | 40* | 40* | - | 20 | 15 | 10 | 15 | 20 | 20 | - |
| HAWAII | 15 | 20 | - | - | - | - | 20 | 20 | 20 | 10 | 10 | 15 |
| INDIA | - | - | - | - | - | - | 20 | 20 | - | - | - | - |
| JAPAN | 15 | 20 | - | - | - | - | 20 | 20 | - | - | - | 15 |
| MEXICO | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 15 | 10 | 10 | 15 | 15 |
| PHILIPPINES | - | - | - | - | - | - | 20 | 20 | - | - | - | - |
| PUERTO RICO | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 15 | 10 | 10 | 15 | 15 |
| SOUTH AFRICA | 20 | 40* | - | - | - | - | 20 | 10 | 10 | 10 | 15 | 20 |
| U.S.S.R. | - | - | - | - | - | - | 20 | 15 | 20 | 20 | - | - |
| WEST COAST | 15/20 | 20/40 | 80 | 160 | 160 | 160 | - | - | - | 10 | 10 | 15 |

**CENTRAL UNITED STATES TO:**

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ALASKA | 15 | - | - | - | - | - | 20 | - | - | - | - | 15 |
| ARGENTINA | 20 | 20 | 20 | 40 | 40 | - | 20 | 20 | 15 | 10 | 15 | 15 |
| AUSTRALIA | 15 | 20 | 20 | - | - | - | 40 | - | - | - | 15 | 10 |
| CANAL ZONE | 15 | 20 | 40 | 40* | 40* | - | 20 | 15 | 10 | 10 | 10 | 15 |
| ENGLAND | 40 | 40 | 80 | - | - | - | - | 20 | 15 | 15 | 20 | 40 |
| HAWAII | 15 | 20 | - | 40 | 40 | 40* | 40* | 20 | 20 | 15 | 10 | 15 |
| INDIA | - | - | - | - | - | - | - | 20 | - | - | - | - |
| JAPAN | 15 | - | - | - | - | - | - | 20 | - | - | - | 15 |
| MEXICO | 15 | 20 | 40 | 40* | 40* | - | 20 | 15 | 10 | 10 | 10 | 15 |
| PHILIPPINES | 15 | 20 | - | - | - | - | - | 20 | - | - | - | 15 |
| PUERTO RICO | 15 | 20 | 40 | 40* | 40* | - | 20 | 15 | 10 | 10 | 10 | 15 |
| SOUTH AFRICA | 20 | 40 | - | - | - | - | - | 15 | 10 | 10 | 15 | 20 |
| U.S.S.R. | - | - | - | - | - | - | - | 20 | 15 | 20 | - | - |

**WESTERN UNITED STATES TO:**

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ALASKA | 10 | 15 | 20 | - | - | - | 40 | 40 | 40 | - | - | 20 |
| ARGENTINA | 15 | 20 | - | 40 | 40 | - | - | 20 | - | 10 | 10 | 15 |
| AUSTRALIA | 10 | 15 | 20 | 20 | - | - | 40* | 40* | 20 | 20 | 15 | 15 |
| CANAL ZONE | 15 | 20 | 20 | - | - | - | - | 20 | 15 | 10 | 10 | 10 |
| ENGLAND | 20 | 40 | 40 | - | - | - | - | - | 15 | 15 | 20 | 20 |
| HAWAII | 10 | 15 | 20 | 40 | 40 | 40 | - | 20 | 20 | 15 | 15 | 10 |
| INDIA | - | 15 | 20 | - | - | - | - | - | 20 | - | - | - |
| JAPAN | 10 | 15 | 20 | - | - | - | 40 | 40 | 40 | - | - | 20 |
| MEXICO | 15 | 20 | 20 | - | - | - | - | 20 | 15 | 10 | 10 | 10 |
| PHILIPPINES | 10 | 15/20 | 15/20 | - | - | - | 40 | 40 | 40 | - | 20 | - 20 |
| PUERTO RICO | 15 | 20 | 20 | - | - | - | 40 | 40 | 40 | - | - | 20 |
| SOUTH AFRICA | 20 | 20 | - | - | - | - | - | - | 15 | 10 | 15 | 15 |
| U.S.S.R. | - | - | - | - | - | - | - | - | 20 | 20 | - | - |
| EAST COAST | 15/20 | 20/40 | 80 | 160 | 160 | 160 | - | - | - | 10 | 10 | 15 |

*Try 80 meters.

**The bands shown represent the highest usable a these times on "Good Days."**

**Note that the lower frequency bands open first and close last.**

## JANUARY 1993

| SUN | MON | TUE | WED | THU | FRI | SAT |
|---|---|---|---|---|---|---|
| | | | | | 1 G | 2 G-F |
| 3 F-P | 4 P | 5 P-F | 6 F | 7 F-P | 8 P | 9 P-F |
| 10 F-G | 11 G | 12 G | 13 G-F | 14 F-P | 15 P-F | 16 P-F |
| 17 F-P | 18 P | 19 P-F | 20 F-G | 21 G | 22 G | 23 G-F |
| 24 F-P<br>31 G | 25 P-F | 26 F-G | 27 G | 28 G | 29 G | 30 G |

## FT-890AT
**Compact HF Transceiver**

- Automatic Antenna Tuner Hybrid High Speed Design Covers 160-10 meters
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- All Mode Squelch
- DFCS-Duct Flow Cooling System
- **Accessories:** Contact your Dealer for full details.

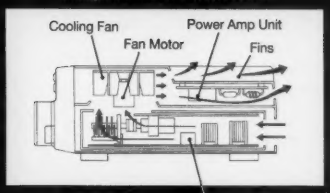
Field days and contesting are challenging. We built the FT-890AT for times when you need the high performance of a base station – like the FT-1000 – but the practicality of a compact, rugged mobile. In fact, the FT-890AT is the mobile version of the FT-1000. Designed to be the world's smallest HF with a built-in antenna tuner, its superior receiving performance is a direct result of FT-1000 technology.

Since field work is demanding, the front panel has been simplified. Seldom used VOX controls are on the back. For faster TX/RX switching, the FT-890AT has two direct digital synthesizers (DDSs). With its unique duct flow cooling system, die-cast aluminum upper case and heat sink, the FT-890AT can't be beat for superior field work and DX-peditions.

Not just a "field" radio, with the optional FP-800 AC Power Supply, MD-1C8 Desk Mic and YH-77ST Headphones you've got a performance-plus base station loaded with features and affordably priced.

To see what that means for you, contact your Yaesu dealer today.

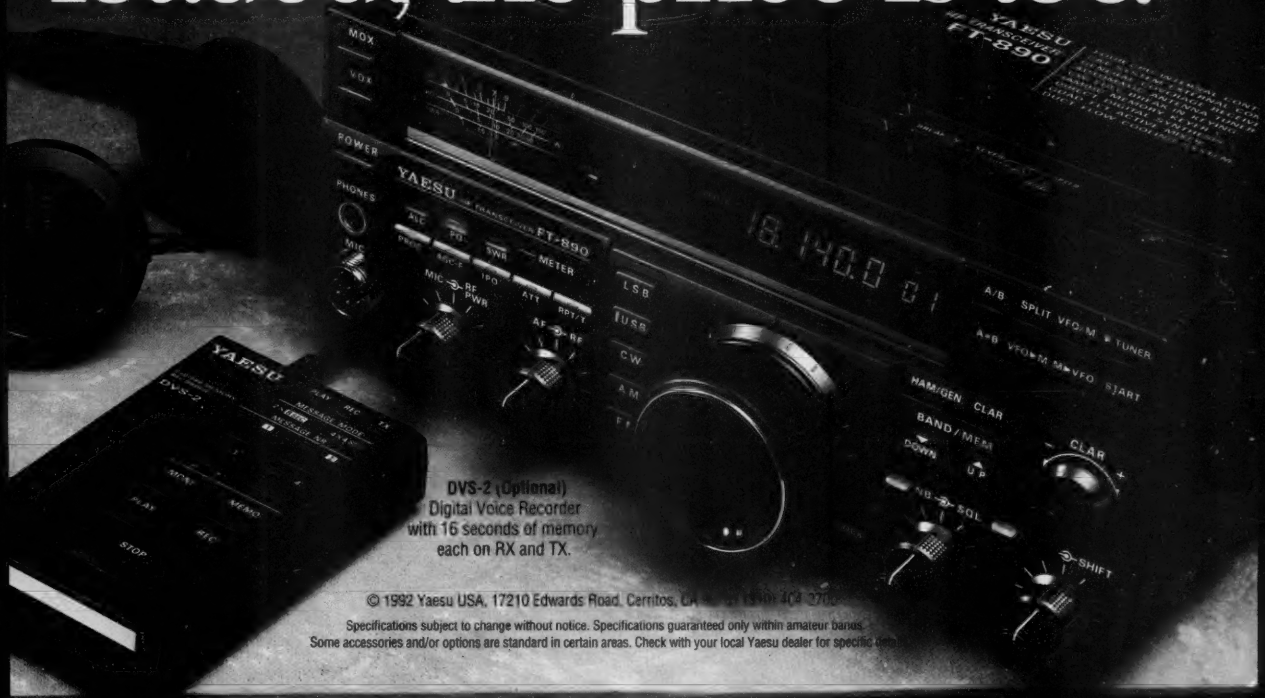
**Duct Flow Cooling System (DFCS)**
Rugged aluminum top panel heat sink and internal thermally switched fan draws air through the heart of the transceiver.




**Built-in Antenna Tuner**
Tunes most antennas 160-10 meters.

YAESU
*Performance without compromise.*™

# Usually if a rig is this loaded, the price is too.




**DVS-2 (Optional)**
Digital Voice Recorder with 16 seconds of memory each on RX and TX.

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Specifications subject to change without notice. Specifications guaranteed only within amateur bands.
Some accessories and/or options are standard in certain areas. Check with your local Yaesu dealer for specific [illegible]

KENWOOD

...pacesetter in Amateur Radio

# Stretch

## Expanded horizons in HF communications

**Equipped with the latest advan in communications technology, Kenwood's TS-850S is a comp tion-class HF transceiver with platinum credentials.**

- **AIP (Advanced Intercept Point) syster**
- **Internal automatic antenna tuner or external antenna tuner (both optional**
- **Ultra-fine (1Hz) tuning**
- **Tunable IF notch filter**
- **IF slope tuning**
- **Optional DSP (digital signal processor**
- **General coverage receiver**

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- **100W power output**
  RF output is 100W (40W in AM mode).
- **Wideband general coverage receiver**
  The TS-850S covers all Amateur bands from 160 to meters.
- **100 memory channels with multi-scan functions**
  Of the 100 memory channels, 90 are available for independent storage of TX and RX parameters. This especially useful for FM repeater use. In addition to programmable memory channel lock-out, there is gr scan, programmable band scan, and variable scan s
- **Kenwood's AIP system for clearer recepti**
  AIP (Advanced Intercept Point) is an exclusive circui design that increases dynamic range to 108dB.
- **Automatic antenna tuner**
  The TS-850S features an antenna tuner (built-in or optional) that automatically searches for minimum S on all bands. The AT-300 external tuner is also avai
- **Ultra-fine (1Hz) tuning**
  The Direct Digital Synthesizer (DDS) and digital PLL system can control the frequency in 1Hz steps.
- **Tunable IF notch filter**
  Provides highly selective filtering with about 40dB c attenuation (for all modes except FM).
- **Optional DSP**
  The DSP-100 can be installed to provide greater sig quality, improved CW operation, and many other be You can actually tailor your CW wave form, and "highlight" your SSB signal.
- **Choice of accessories**
  Two matching power supplies, the PS-52 and PS-31 available, as well as a complete line of optional accessories. Contact your authorized Kenwood Ama Radio dealer for details.

# TS-850S

**HF Transceiver**


KENWOOD U.S.A. CORPORATION
COMMUNICATIONS & TEST EQUIPMENT GROUP
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